3. *Revision of the Indigenous Freshwater Fishes of the S.W. Cape Region.*—By K. H. Barnard, D.Sc., F.L.S., Assistant Director.

(With 33 Text-figures.)

This constitutes the twelfth report in connection with my researches on the fauna of the mountainous areas of the S.W. Cape, aided by grants from the Royal Society of South Africa (1917) and the Research Grant Board (1928–1941), to both of which bodies my thanks are tendered.*

The introduction of Trout many years ago, and the recent establishing of the Black Bass in the rivers of the Cape, necessitate a prompt survey of the indigenous fish-fauna. This survey is essential for scientific purposes, and for any discussion of the former relationships and possible changes in the river-systems. There are admittedly many difficulties in the way, but it is sincerely hoped that such a survey will be undertaken.

With a view to putting the nomenclature of the fishes of this region on a more satisfactory basis, I have re-examined the material of the relevant species on which Gilchrist and Thompson worked (Ann. S. Afr. Mus., xi, pts. 5 and 6, 1913 and 1917), together with considerable new material either supplied by Mr. A. C. Harrison, Hon. Sec. of the Cape Piscatorial Society, and other correspondents, or collected by myself and other members of the Museum staff.

In the course of this study several unexpected queries and interesting facts have cropped up, necessitating some changes in the nomenclature and synonymy of the Cape species. I have not attempted to deal with any species found outside the somewhat arbitrary limits here adopted for the "S.W. Cape" region, or to express any definite

* Previous reports: 1. "Freshwater Crustacea," Trans. Roy. Soc. S. Afr., vol. xiv, 1927. 2. "Colophon (Coleoptera)," *ibid.*, vol. xviii, 1929. 3. "Alder-flies," *ibid.*, vol. xix, 1931. 4. "May-flies," *ibid.*, vol. xx, 1932. 5. "Terrestrial Isopoda (Woodlice)," Ann. S. Afr. Mus., vol. xxx, 1932. 6. "Further New Species of Colophon," Stylops, vol. i, pt. 8, 1932. 7. "A New Corduline Dragonfly," *ibid.*, vol. ii, pt. 7, 1933. 8. "Caddis-flies," Trans. Roy. Soc. S. Afr., vol. xxi, 1934. 9. "Stone-flies," Ann. S. Afr. Mus., vol. xxx, 1934. 10. "Dragon-flies," *ibid.*, vol. xxxii, 1937. 11. "Additions to Alder-flies, May-flies, Caddis-flies, etc.," *ibid.*, vol. xxxii, 1940.

opinion on the identity or otherwise of the extra-territorial specimens assigned (erroneously in my opinion) to Cape species. My endeavour has been to find out what well-defined species can be recognized in the Cape, and to characterize them specifically in all stages of growth as far as possible. Comparisons with other species have been necessary, and where the results appear to shed light on the nomenclature of the species, they have been included.

"*The advancement of systematic Zoology is best served, in the present state of the science, not so much by the description of new species, as by the revision and putting in order of the species that are supposed to be already known*" (Calman, Nature, cxli, no. 3567, p. 452, 1938).

This study is merely a beginning, for there are many gaps in our knowledge of some of the species, and many rivers whose fish-fauna has not been investigated.* The results, so far obtained, show that the whole life-history of the species in each river or river-system should be studied, preferably by someone who is on the spot and does the collecting himself, or who can rely on a good collector and the accuracy of his data.

Only in this manner can one appreciate the true nature of certain abnormalities and variations, which is not apparent except in conjunction with long series of normal specimens. Some of these, which I have been able to examine, would probably become the types of nominal or "Museum species," if they got into the hands of a systematist without full data and extensive material for comparison. The description of "n. spp." based on single specimens, especially by overseas specialists, however eminent, without knowledge of the local geography, is liable to lead to confusion, and is to be deprecated. *Cf.* Pappenheim's remarks on the difficulty of identifying single specimens from different localities (Schultze, Reise . . . Südafr., iv, p. 277, 1910).

The monographs of Boulenger (Catalogue of Freshwater Fishes of Africa, vols. i–iv, 1911–1916) and Gilchrist and Thompson (*l.c.*) are of great value, in spite of their authors having had no field acquaintance with the species. Boulenger, as is shown below, failed to examine certain type specimens, and thereby came to adopt entirely wrong conceptions of at least two species. These misconceptions were followed, quite unsuspectingly, by Gilchrist and Thompson, whose work contains in addition several misprints and errors; and

* I have not been able to extend my investigations to, *e.g.*, the Sundays River, owing to War conditions and Museum administrative duties thrown upon me by the Director's retirement (Jan. 1942).

also more recently by J. L. B. Smith (Guide to Vertebrate Fauna of Eastern Province, Albany Museum, Grahamstown, pt. 2, Fishes, 1937). Several papers on South African freshwater fishes have been published since 1917, but only three contain any new matter concerning the fauna of the area here discussed (J. L. B. Smith, 1936, and K. H. Barnard, 1937 and 1938).

Measurement and Colour.—As regards the length of specimens, Mr. W. W. Thompson (who did most of the practical work for the joint monograph) was not always consistent in his measuring, sometimes including the caudal rays, sometimes not. In the present paper the *total length* is measured as from the tip of the snout to the end of the middle caudal rays; but for the ratio of head to length, the *body length* is reckoned only to the end of the scales on the caudal peduncle (*i.e.* the "standard length").

The depth of the body may vary so much according to the condition of the specimen, its sex and maturity, and the method of preservation, that it is of minor taxonomic importance. Among the species herein dealt with, it is useful as a diagnostic character only in the case of *Barbus asper* and *tenuis*.

Colours, when given, are taken from the living fish. After preservation the coloration is rarely a reliable guide, as it may vary according to the method of preservation, and fades in course of time; dark lateral stripes are usually more conspicuous after preservation than in the living fish.

Tables of Growth-changes.—These tables are intended to give an epitome of the life-history and growth-changes of the species. As far as possible they have been compiled from series of individuals collected in the same or a nearby locality, preferably at the same time and place; and preserved in the same manner. In the great majority of cases the ratios, etc. represent the averages of several specimens of each size.

It must not be expected, however, that individuals from other localities, or even all individuals from the same locality, will conform exactly in all details. Dwarfing may occur in small-sized streams, or owing to poor food-supply, or other factors; and allowance must be made for this.

Method of preservation is also a factor to be considered. Comparison of specimens preserved in formalin with those preserved in alcohol may lead to different results. Further, the preserving fluid may be either weak or rather too strong, resulting respectively in flacidity or rigidity of the muscles, and possibly a slight increase or

decrease in the length of the body. The fleshy tip of the snout may be considerably modified by the kind and strength of preservative. Hence in a measurement any fraction less than $\frac{1}{4}$ or $\frac{1}{5}$ is really meaningless.

Abbreviations used in the tables. *TL*, total length, *i.e.* from tip of snout to end of middle caudal rays, in millimetres. *L*, body length, *i.e.* from tip of snout to end of scales on caudal peduncle. *H*, head-length. *E*, eye-diameter. *S*, snout. *I*, interorbital width. *d.a.n.*, distance between anterior nostrils (*Gephyroglanis*). *l.l.*, lateral line scales. *c.ped.*, scales around caudal peduncle. *str.*, striae on exposed (posterior) field of scale (main striae, not short intercalaries). *g.r.*, gill-rakers on upper and lower parts of anterior arch. *barb.*, barbels. *p*, posterior, *a*, anterior; (*p*) and (*a*) indicate that the barbel is just beginning to show. *d.sp.s.*, serrations on dorsal spine. The *barb.* column is left blank after the barbels (one or both pairs according to the species) have fully appeared.

Acknowledgments are made: to Mr. A. C. Harrison, Hon. Secretary of the Cape Piscatorial Society and Inland Fisheries Advisory Officer, for enthusiastic help and co-operation, and to Mr. A. T. Packham, another member of the same Society; to Mr. F. G. Chaplin, Curator of the Jonkershoek Fish Hatcheries; to the late Mr. A. E. Manley, of the Olifants River Irrigation Scheme, Klaver; and to my colleagues on the South African Museum staff—Dr. A. J. Hesse, Dr. L. D. Boonstra, and Mr. C. W. Thorne. To Mr. Thorne I am especially grateful for his untiring energy in collecting. To my overseas correspondents I also express thanks: to Mr. J. R. Norman, and more recently Dr. E. Trewavas of the British Museum, for information concerning Boulenger's material; and to Dr. de Beaufort of Amsterdam, and Dr. E. Ahl of Berlin, for the loan of types and other material essential for the present study.

To numerous farmers and owners of property grateful acknowledgment is made for permission to camp and for other facilities.

To the late Mr. E. H. Cooke of Cape Town, and to his son Mr. Vernon Cooke, my thanks are due for the use of a light-weight boat, without which netting operations in many localities would have been impossible.

Topography.

The area embraced in this study is the south-western portion of the Cape Province, approximately as far north as 31° S. and as far

east as Port Elizabeth, 25½° E. Certain species living in the lower Orange River are included because the South African Museum has recently obtained important material illustrating their growth-changes.

Of the rivers in this area, the Berg and the Olifants (Clanwilliam) rivers run approximately north-westwards to the Atlantic Ocean; the others flow southwards and south-eastwards, arising on the south side of the main Cape watershed (fig. 1).

This main Cape watershed runs from about Tulbagh north-eastwards to Matjiesfontein and along the line of the Klein Roggeveld, Komsberg, Nieuwveld, and Sneeuwberg ranges.* North of this line, and east of the Roggeveld escarpment, lie the catchment areas of the southern tributaries of the Orange River. The formation of this watershed, which appears to have had an important influence on the distribution of the fish-fauna, is considered to have occurred or to have been intensified during Tertiary times.†

From Tulbagh a continuous chain of mountains strikes south-wards and south-south-westwards to Cape Hangklip. The fish-fauna, and also the distribution of certain insects, indicates that these mountains have been a barrier of some importance.

In the northern part of the Cape Peninsula only the rivers arising on the eastern and southern slopes of Table Mountain, Constantia Berg and the Kalk Bay Mts. contain fishes. Of these the Black River (with its tributaries the Liesbeek and Kromboom streams) flows northwards into Table Bay; the Palmiet River flows southwards into Hout Bay on the Atlantic coast; the Diep River and Silvermine River drain southwards into False Bay (fig. 28).

In the southern part of the Peninsula the highest land is on the east side, and a few more or less perennial streams flow westwards, *e.g.* the Bokram, Schusters, and Klaasjagers rivers (fig. 28).

There are several lakes (vleis) on the Cape Flats (isthmus) which are more or less interconnected, at least during periods of heavy rainfall. The poverty of the fish-fauna (*Galaxias* and *Sandelia* only) of the streams on the Cape Peninsula and the adjacent (western) portion of the Cape Flats is evidently due to the whole isthmus between Table Bay and False Bay having been formerly under the sea.‡

* Rogers, Trans. S. Afr. Philos. Soc., xiv, p. 375, 1903.

† Rogers, *l.c.*, 1903. See also Barnard, S. Afr. Geogr. J., xix, p. 6, 1936.

‡ Haughton, Geology . . . Cape Town, Explan. Sheet 247, Geol. Surv., p. 58, 1933.

FIG. 1.—River-systems of the S.W. Cape.

× Low watershed between Berg River and Breede River systems.
× × Watershed between Olifants River and Breede River systems.
× × × Low watershed between Olifants River and Gouritz River systems.

The outcome of this study seems to show that the species living in the south-western corner of the Cape Province are confined to this area. There are a few records (*e.g.* see under *B. burchelli*) which appear to refute this generalization; but those specimens which I have been able to examine have proved to be erroneously identified.

The fact that each river-system harbours its own characteristic species may be found to be more strikingly exemplified in the S.W. Cape than in regions farther east and north-east.

Whether any of the typical Cape species (excluding those of the Orange River) will eventually be found to inhabit other river-systems in Natal, or the Orange Free State and Transvaal, remains for some future investigator. But, as already remarked, the investigation of these Provinces should not be delayed. And the caution may be repeated that single specimens, or records based on such, are useless unless supported by a thorough study (field and laboratory) of the species living in each river-system.

In examining the above areas, the possibility of river piracies, such as have occurred in the S.W. Cape, must be borne in mind.* Some of those in the S.W. Cape may be noted here. The Steenbras River now flows through the strike of the Hottentots Holland range, but its headwaters obviously drained formerly into the Palmiet River (fig. 1, between the numerals 4 and 5). The Klein River (Stanford) has tapped the Hartebeest River, which appears to have formerly flowed into the Kars River (Bredasdorp), and thus formed part of the Breede River system (fig. 1, above the numeral 6). In this latter case, the presence of the "red-fin" *Barbus vulneratus* as a relict in the Hartebeest River would not be surprising; we were informed by a local farmer that there were "red-fins" (rooi-vlerke) in the river, but our netting operations have failed to find any true "red-fins" (*Barbus*) (see pp. 120, 248).

These are two examples of relatively minor piracies. On the other hand, the two following may be regarded as major piracies, as they affect adjacent, but totally distinct, drainage systems. The Little Berg River, flowing through Tulbagh Poort, has tapped the former source of the Breede River (fig. 1, between the numeral 3 and ×). The tributary of the Breede River which has cut back through Michell's Pass appears to have tapped streams which may formerly

* Barnard, *l.c.*, pp. 8, 9, 1936. Haughton, Geology . . . Gamtoos Valley, Explan. Sheet 151, Geol. Surv., p. 8, with map, 1937. J. de Villiers, Tr. Geol. Soc. S. Afr., xli, pp. 38, 40, map on p. 39, 1939.

have drained eastwards into the Touws, and thence into the Gouritz River (fig. 1, at ×). These two piracies, especially the first, may possibly have had some effect on the fish-faunas (*cf.* p. 114).

Geological Considerations.

No fossil representatives of the genus *Barbus*, or of Catfishes (*Clarias*, etc.), are known from pre-Tertiary formations.* The present fish-fauna must have spread over South Africa during or since the Tertiary epoch. Nevertheless a brief epitome of the main geological events which have contributed to the making of the South African region may be included. It may help us, not so much to visualize the conditions under which the present fish-fauna has been evolved and dispersed, as to realize the difficulties in the way of a satisfactory explanation.

At the beginning of the Jurassic period South Africa was a vast waste of lava plains in process of elevation, and as the whole country except the coastal border has been dry land ever since, the main drainages, mostly radiating from the highlands of Basutoland, date from that time.†

Mountain building (N.–S. Cedarberg folds, and E.–W. Zwartberg folds) was reaching its climax, although these folds were renewed and intensified later. The Cretaceous deposits were laid down in intermontane troughs in the folded (coastal) belt, but their extent to the west and south-west is uncertain.‡

Marginal faulting (Worcester fault, etc.) occurred, and also, which is perhaps more important from our present point of view, cross-flexuring. A series of basins was thus formed, in which the Cretaceous beds are to-day preserved. And the primitive E.–W. drainages were converted into N.–S. drainages cutting across the mountain ranges, and by later entrenchment right through the ranges in some cases. It may be noted that the Breede, Gouritz, and Gamtoos river-systems each contains its remnant of Cretaceous beds; and *each contains at the present day its own characteristic fish-fauna* (fig. 6).

It is not, of course, intended to imply that the fish-fauna dates from Cretaceous times (there is no record of any freshwater Cretaceous fish-fauna in South Africa); but the cross-flexuring may have had two results: one geological, one faunistic.

* Meek, Migrations of Fish, pp. 170, 176, 1916.

† This account of the geology is based on A. du Toit, Geology of South Africa, pp. 437–543, 1926.

‡ Rogers, *l.c.*, 1903. See also Rogers, S. Afr. J. Sci., xix, p. 23, note 17, 1922.

The Tertiary uplift and planation caused the removal of most of the Cretaceous deposits, and intensified the main Cape watershed and the entrenchment of the N.–S. rivers. Allusion has already been made to various piracies.

We cannot but look towards Central Africa for the source of our freshwater fish-fauna, except possibly in the case of *Galaxias* (see p. 113). Freshwater and subaerial deposits were being laid down on the Jurasso-Cretaceous Kalahari peneplain, under varying climatic conditions.* But there is no fossil evidence, and before any attempt is made to explain the origin of the S.W. Cape fish-fauna the other areas (Natal, etc.) must be studied, and also the phyletic relationships of the species, *e.g.* of the species of the genus *Barbus*.

On the south coast an Eocene peneplain was cut by the sea, and continued inland by the rivers as far as the southern Karroo (fig. 24). It seems to have been connected, *via* the Cape Flats, with the Saldanha Bay and Olifants River (Clanwilliam) peneplain (du Toit only says "possibly connected" and makes no allusion to the Cape Flats). The distribution of *Galaxias* in South Africa may perhaps have been determined at this period (p. 113).

Elevation continued until the Agulhas Bank and the whole of the continental shelf, as far as the present 400-fathom isobath, were laid bare. Some of the old river courses are still traceable in spite of their re-submergence in late Pleistocene times.†

The extension of the river courses across the Agulhas Bank is an interesting point. Both du Toit and Krige consider that the extended Breede River joined the extended Gouritz River. *But the fish-faunas of the two rivers are totally different* (p. 123). Had these two rivers (and others also) at that time the same, undifferentiated, fauna? Or were they never connected? The latter seems more plausible. Moreover, it is safe to say that two intervening rivers, viz. the Duivenhoks and Kafferkuils rivers, at the present day relatively small and cut off short by the coast-line, were formerly tributaries of the Breede and not of the Gouritz River, because they contain *Barbus vulneratus* (characteristic of the former), but not one of the species found in the latter river (*Galaxias* excepted) (fig. 1).

The fish-fauna of the Kromme River and Zwartkops River, and

* Rogers, Post-Cretaceous Climates, S. Afr. J. Sci., xix, pp. 1 sqq., 1922. See also F. Dixey, Tr. Geol. Soc. S. Afr., xli, p. 113, 1939.

† In addition to du Toit, *l.c.*, 1926, p. 443, see du Toit, S. Afr. Geogr. J., v, pp. 9–12, 1922, and xvi, pp. 4–5, 1933; A. V. Krige, Ann. Stellenb. Univ., v, sect. A, No. 1, pp. 14–19, 1927.

the intervening rivers, points to a former connection on the Agulhas Bank. But the evidence is scanty. Some rivers in the Gamtoos system require further investigation.

Hydrogen-ion Concentration.

Many observations have been made and collected by Mr. A. C. Harrison for purposes of testing the suitability of the Cape rivers for the introduction of trout, black-bass, etc. With the reagent supplied by Mr. Harrison I have also tested the water of many rivers which Mr. Harrison has not had an opportunity of visiting. On these combined observations are based the following general statements of the pH character of the different rivers.

Rivers and streams arising in the Table Mountain Sandstone mountains of the S.W. Cape are as a rule neutral (pH 7–7·5) in their middle and lower reaches. After winter rains, however, they may become slightly acid owing to sudden scouring of the upper reaches where the streams flow through boggy areas with abundant Sphagnum and decaying vegetation. *E.g.* the middle reaches of the Olifants (Clanwilliam), Berg, Breede, and Eerste rivers.

Where the topography is especially favourable to the formation of sphagnum bogs and vegetable cover, such as the dip-slopes facing south or south-east in the folded mountain ranges, and where there is a comparatively short run between the source and the mouth, the rivers are acid, sometimes strongly acid (pH 4–5·5). *E.g.* Silvermine (Cape Peninsula), Steenbras, Palmiet, streams between Onrust and Hermanus, and the rivers flowing *south* from the Outeniqua-Tsitsikama mountains (from George eastwards to near Humansdorp).

When, however, the sources of the rivers, or the major portion of the catchment area, lie on the Malmesbury and Bokkeveld formations, the water is either neutral or distinctly alkaline (pH 7–8·5). *E.g.* Diep-Mosselbank rivers (Malmesbury), lower portions of the Olifants (Clanwilliam), Verloren Vlei, and Great Berg rivers, Zout River (Bredasdorp).

Alkalinity is especially characteristic of the two large rivers, the Gouritz and the Gamtoos, which have their sources in, and for the most part flow over, the Karroo formation. Some of the smaller tributaries arising on Table Mountain Sandstone mountains are acid at their headwaters, but their water is swamped in the great volume emanating from the major tributaries.

If the map of the river-systems (fig. 1) were coloured red and blue

to indicate respectively acidity and alkalinity, the extreme south-west area and the coastal belt from about George eastwards to Humansdorp would appear for the most part red; while dividing these two red areas would be a large blue patch representing the catchment basin of the Gouritz; another blue patch farther east representing the Gamtoos basin.

It is perhaps possible that the noticeable absence of large-sized species of *Barbus* from the Gouritz, Gamtoos, Sundays, and other rivers may be due to this alkalinity (*cf.* p. 112).

Outstanding Features of the Freshwater Fish-fauna of the S.W. Cape.

1. The whole family of *Cichlidae* is absent from the area under discussion. Gilchrist and Thompson's record of *Tilapia natalensis* from Lakeside, Cape Peninsula (*l.c.*, p. 487), was due to an error in labelling: Lakeside was the domicile of the donor of the specimens, not the locality where the fishes were caught.*

There are no *Cyprinodontidae*. The locality given for *Fundulus*

* For Smith's types of *T. sparrmanii* Boulenger (1915, *l.c.*, iii, p. 208) gives the locality as "Namaqualand, N. of Orange R." Trewavas (1936, Novit. Zoolog., xl, p. 72) also says Namaqualand. But Smith merely said "north of Orange R." Actually the type locality is Boetsap, *eastern* Bechuanaland (see Note on Andrew Smith, p. 117).

Trewavas (1936, *l.c.*) records no Cichlids from south of the Otavi region in South West Africa. None were collected in the Gt. Fish River (tributary of the Orange River) or in the Orange River at Goodhouse or the Aughrabies Falls by the South African Museum expeditions in 1936 and 1939.

Fowler's reference (Ann. Transv. Mus., xvi, p. 286, 1935) to Weber's locality for *Haphochromis moffatii* is a misquote: Weber gave two localities in Natal, not "Vivolsdrift, Klein-Namaqualand" [*sic*=Violsdrift].

The South African Museum has no records of any Cichlids from south-west of a line between (approximately) Kuruman and East London (*cf.* Weber, 1897, Zool. Jahrb., x, p. 195).

Some examples of *T. mossambica* were introduced into a dam on the farm "Highlands," Malmesbury, by Mr. W. R. Hewett in 1937. Since then they have been placed in other dams in the neighbourhood, and are flourishing and multiplying. In January 1940 they were found (A. C. H., K. H. B., and C. W. T.) to be spreading to one of the tributary streams of the Diep River at Malmesbury, and there seems every likelihood of their extending to the main Diep River and becoming an integral part of its fauna. It is therefore important to note that *T. mossambica* is not a *natural* component of the fauna of this river.

Haplochromis philander (Gilchrist, Mar. Biol. Rep., no. 1, 1913, p. 69, pl. 3, as *Tilapia philander*) has been introduced at the Jonkershoek Fish Hatchery, but does not seem to have escaped from captivity into the Eerste River.

capensis Garman, 1895—"False Bay, Cape of Good Hope"—cannot be taken seriously. The most charitable explanation is that "False Bay" refers to the subsidiary bay of that name inside St. Lucia Bay in Zululand. *F. mkuziensis* Fowler, 1934, came from the Umkuzi River, which flows into St. Lucia Bay.

Gambusia has been introduced into Groen Vlei (between George and Knysna) and other places for mosquito control and as a forage-fish.

2. The presence of the Catfish (*Gephyroglanis*) in the Orange and Olifants (Clanwilliam) rivers. The absence of *Sandelia* is a further, though negative, link between these two rivers.

3. The absence of *Clarias* from the *southern* tributaries of the Orange River (so far as the Cape Province is concerned); *e.g.* the Kraai River (Aliwal North), Ongar (or Ongers) River (Richmond–Prieska Divisions), and Zak–Hartebeest River (Kenhardt Division). Although well adapted for existence in periodic rivers, *e.g.* the Molopo, Kuruman, and Gt. Fish (S.W.A.) rivers, there are no records from the southern tributaries. This may be due to lack of collecting, or possibly temperature may be a restricting factor.

4. The absence of *Labeo* and the *anoplus* group of *Barbus* in any river south-west of the Olifants–Gouritz systems.

5. The absence of large-sized species of *Barbus* from all systems south of the main Cape watershed, except the Breede River, until Natal is reached.

6. The presence of a group of small *Barbus* with "red-fins" in the south-west and southern areas as far east as (and including) the Zwartkops River, and, so far as we yet know, confined to these areas.

7. The absence of *Sandelia* in the Olifants River (Clanwilliam) although *Galaxias* is present.

8. The presence of *Galaxias* in the rivers on the Tertiary sea-cut terrace around the south-west and south coasts, and its extension to inland localities drained by the headwaters of these rivers (fig. 24).

The explanation of these rather remarkable features of distribution is not easy. The full facts are not yet available. For example, are the red-fin species really confined to the S.W. Cape; are they absent from the Orange River system and the rivers of the Eastern Province and Natal, and the Transvaal and East Africa? In tracing the distribution of these species reliance should only be placed on *living* specimens, not on "Museum" specimens which may *appear* to belong to, or have been "identified" as, species known to be red-fins (*e.g.* Boulenger's "*burchelli* " from Deelfontein).

Are there really no large, radiately striate scaled *Barbus* in the Orange system, or indeed anywhere south of the Limpopo system, until one reaches the south-west corner of the Western Cape Province?

Are there really no large-sized, either longitudinally or radiately striate scaled, *Barbus* in the rivers east of the Breede River until one reaches Natal? In the present state of our knowledge it seems that not only is the presence of *B. andrewi* in the Breede River an anomaly, but the presence of *any radiately striate scaled large Barbus* in the Olifants–Berg–Breede area is a greater anomaly. The nearest such species is *B. rapax* from the Transvaal.

It is a reasonable assumption that *B. capensis* has been derived from *holubi* (or both from a common ancestor); *serra* and *andrewi* may be closely allied to one another, but not to either of the longitudinally striate scaled species.

It is legitimate to suggest queries for future research to investigate, but speculation without much fuller data than we yet possess is not advisable.

Nevertheless, perhaps the following suggestions may be made. The distribution of *Galaxias* over the Tertiary peneplain on the west and south coasts offers little difficulty in view of the marine ancestry of these fishes (and the katadromous habits of some of them at the present day). The explanation is all the *easier on the basis of the Continental Displacement hypothesis* and the one-time close juxtaposition of the southern continents.*

Sandelia seems to have been a later immigrant, from the east, which managed to spread over the whole of the southern Tertiary peneplain and the Cape Flats and Berg River area, but which seems to have been in some manner prevented from entering the Olifants system, and also the southern part of the Cape Peninsula. Although formerly, before the Tertiary uplift had given impetus to erosion, the watersheds were much less well-defined and the possibilities of intercommunication (by flooding) greater, we must assume that the watershed between the Gouritz and Olifants rivers, even at Karroo Poort, was sufficiently marked to prevent the migration of *Sandelia* (fig. 1, × × ×). On the other hand, even at the present day the watershed between the Breede and the Little Berg rivers in the

* Sir A. C. Seward: "It is difficult, it is probably impossible, to explain the facts without calling to our aid the hypothesis of drifting continents. . . . I can do little more than reaffirm adherence to the view that plant records from rocks of many ages raise problems which seem to be insoluble unless we postulate movement and sliding of the earth's crust."—Nature, vol. 144, no. 3644, Suppl., p. 424, Sept. 1939.

neighbourhood of Tulbagh is comparatively low (fig. 1, ×). The capture of the headwaters of the Breede River by the Little Berg River may have been the means of introducing *Sandelia* from one (? the former) into the other (? the latter).

And if this transference occurred in the case of *Sandelia*, may it not also have happened to *B. andrewi*? But if so, in which direction, from the Berg River into the Breede River or *vice versa*?

And if *serra* and *andrewi* are derived from one another (or a common ancestor), where and when were the drainage systems of the Olifants on the one hand, and the Berg–Breede on the other hand, in (periodical) intercommunication? So far as one can judge from the present-day topography, the most likely place is the Witzenberg Vlakte between the Witzenberg Range and the Schuurfteberg Range (near Gydo, north of Ceres) (fig. 1, × ×). Here the actual sources of the Olifants and the Dwaars (Ceres) rivers arise on the same intermontane plain. But as I have suggested elsewhere, the headwaters of the Dwaars once flowed, not through Michell's Pass into the Breede River, but eastwards into the Kasdies River and Touws River drainage, thence to the Gouritz system.* Thus it is necessary to introduce a time element, and to suppose that the Michell's Pass river, in cutting its way back, first tapped the sources of the Kasdies River before reaching the Witzenberg Vlakte, where intercommunication with the Olifants River might have been possible. If this did happen, one might have expected to find the *anoplus* group represented in the Breede River system. But it is not represented. Thus one speculation leads to another!

Note on Sir Andrew Smith's Species.

Andrew Smith described and figured the following freshwater fishes in "Illustrations of the Zoology of South Africa." Bound copies bear the date 1849, but the work was issued in parts prior to that date (see Waterhouse, Proc. Zool. Soc. Lond., 1880, p. 489), viz.:

1840. Part 9. Plate 5. *Tilapia sparrmanii* [original spelling].
1841. Part 14. Plate 10, fig. 1. *Barbus capensis.*
fig. 2. *Barbus marequensis.*
Plate 11, fig. 1. *Barbus burchelli.*
fig. 2. *Barbus pallidus.*
Plate 12, fig. 1. *Abrostomus* [=*Labeo*] *umbratus.*
fig. 2. *Abrostomus capensis.*
1845. Part 23. Plate 27. *Clarias capensis* [=*gariepinus*, not *capensis* C. and V.].

* *L.c.*, p. 9, 1936.

Of these species the types, *i.e.* specimens considered by Boulenger to be the types, of *T. sparrmanii*, *Barbus capensis* and *marequensis*, and *Clarias capensis*, are in the British Museum.

The figures of these species are coloured, and give the impression of considerable accuracy on the part of the artist. When, however, the number of scales represented by the artist in the coloured figures (both freshwater and marine species, but excluding of course *Clarias* and other scaleless species) is compared with the number found in actual specimens, it is seen that the artist has inserted too many (in some cases far too many) scales.* To take one case where Andrew Smith has (exceptionally) stated the number of scales, *T. sparrmanii*: "about 10 longitudinal rows, from 23–27 scales in each"—the artist has shown at least 37 scales along the middle of the side of the body. In other cases Andrew Smith did not state the number of scales.

Dr. V. Fitzsimons has examined the remains of Andrew Smith's collection of Reptiles and Amphibians, and his remarks relative to the descriptions and figures may be quoted here. "It is apparent that in many of his original descriptions Smith had more than one specimen before him, and although at a later date these species were figured, there is no guarantee that he actually figured one of hi original specimens. Some of the actual specimens figured by him in his "Illustrations" are now in the British and Royal Scottish Museums, and in spite of the doubts expressed above, I feel that it would be quite legitimate to regard these as the types, in the absence of any proof to the contrary. In other cases the evidence available points often to composite descriptions and even composite figures, and in such the definite localizing of the type is impossible." †‡

I have shown that Andrew Smith's description of *Barbus capensis* is accurate as far as it goes, and includes one essential character, namely, the scale-sculpture; but although he gives its true habitat, he states that it also inhabits an entirely different river, which latter statement we now know to be erroneous. §

In this case the type was fortunately extant, and the confusion arising out of Boulenger's Catalogue could be rectified. But the

* In the uncoloured figures this discrepancy is not found, or is very much less noticeable, thus suggesting a different artist.

† Ann. Transv. Mus., xvii, p. 260, 1937.

‡ In reply to an enquiry addressed to the Royal Scottish Museum, Mr. A. C. Stephen, Keeper of the Natural History Department, states (1/xii/37) that there are no fishes in Sir Andrew Smith's collection preserved in that Museum.

§ Ann. Mag. Nat. Hist. (10), xix, p. 304, 1937.

absence of the types of *B. burchelli* and of *Labeo umbratus* and *capensis* leaves no alternative to the adoption of Boulenger's diagnoses of these species.

It is impossible to say whether *B. burchelli* was founded on *burchelli* (as now defined) or on *vulneratus*. The type of *pallidus* also is lost, and no author has claimed to have recognized it, or has identified specimens with it. Boulenger thought it might have been based in part on *vulneratus*, but the size (2 in., 9 lines) alone excludes this species and the other "red-fin" species, all of which develop their "red-fins" considerably before reaching this length. There is no doubt in my mind that Boulenger's *hemipleurogramma* is really Andrew Smith's *pallidus*. The two species of *Labeo* are discussed below (p. 125).

Andrew Smith's collection of freshwater fishes was in all probability derived from various localities and various sources. He himself travelled widely in the Colony; he instituted and was the first Curator of the South African Museum established in Cape Town in 1825.*

The localities given by Andrew Smith in the "Illustrations" do not help much. Although he mentions the Olifants, Breede, and Orange rivers in some cases, for the very two species of *Barbus* whose types are missing and whose exact status is thus, to some extent, doubtful, he gives only a general locality: "various rivers of the Cape Colony" (*B. burchelli*); "clear streams in various parts of the Cape Colony" (*B. pallidus*).

On the chance of finding an entry recording the capture of freshwater fishes on the Expedition led by Andrew Smith in 1834 from Port Elizabeth *via* Graaf Reinet and Colesberg to Philippolis (*i.e.* within the region covered by the present paper), I have consulted the original MSS. Diary, which is in the South African Museum. This Diary, however, only begins with the departure from Graaf Reinet, and contains no reference to the capture of any fishes *en route* until the Expedition reached Boetsap (Bootscap). As this record and a

* See A. Michie, Memoir of Sir A. Smith, Trans. Berwickshire Naturalists Club, Alnwick, 1877; A. Roberts, Ann. Transv. Mus., xviii, p. 271, 1936; V. Fitzsimons, *ibid.*, xvii, p. 259, 1937.

Chief expeditions (dates taken from Michie): Kaffirland, 1824–25; West coast to Orange River, 1828; Natal and Zululand (with Krebs and Drège), 1830; Port Elizabeth to Graaf Reinet, Philippolis, Basutoland, Kuruman, and Limpopo River, 1834–35.

P. R. Kirby, "Andrew Smith, M.D., Founder of the First South African Museum," Ann. S. Afr. Mus., xxxvi, pp. 1–26, pls. 1–5, 1942.

later one in the Diary enable the type localities of two of Andrew Smith's species to be fixed, they may be quoted here.*

At Boetsap on 23rd January 1835 Andrew Smith obtained "Fish No. 76" (published Diary, i, p. 228). The description of the coloration, which mentions the anterior and posterior portions of the dorsal fin, corresponds unmistakably with the coloured figure (pl. 5) of *Tilapia sparrmanii* in the "Illustrations." The type locality for this species, therefore, may be accepted as the Hartz River near Boetsap, Bechuanaland, Cape Province.

On 15th August 1835 Andrew Smith records: "A fish with four palpi to the upper lip was this day caught in the Marique [=Marico River] nearly if not same that occurs in the Orange River. It appeared thicker in proportion to its length than those of the last-named river. It was of a fine green colour, the scales edged with golden yellow; belly and chin white; under lip yellowish white; eyes silvery, clouded in some parts with bronze, and a fine bright golden yellow ring margined the pupil; fins greenish, pectoral ones purplish at base on outer scale; upper lip pale yellowish green" (published Diary, ii, pp. 161, 162). On this date the Expedition was alongside the Marico River near where it reaches the border of Bechuanaland at Deerdepoort and Sekwani, east of Gaberones (Kirby's map in Diary, ii).

This place must be regarded as the type locality for *Barbus marequensis*, though perhaps it would be rash to assume that the so-called type specimen in the British Museum actually came from the Marico River. Fresh specimens from this locality should be obtained, and a re-examination of the type specimen would not be superfluous.

From the shape of the anal fin in the figure in the "Illustrations" (pl. 10, fig. 2) the species is one with longitudinally striate scales (*cf.* p. 144), although Andrew Smith is not so definite on this point as he is in the case of *B. capensis*; further, he says "scales very large," his figure shows about 45 in the lateral line, and (apparently) 14 around the caudal peduncle; whereas Boulenger (1911, Cat. Fw. Fish. Afr., ii, p. 36) gives 33 and 12 respectively. The figure shows the last dorsal spine as rather strong, and accentuated by bright yellow colour; Boulenger describes it as rather feeble (see further p. 160).

* This Diary has now been edited by Prof. P. R. Kirby, and published as Nos. 20 and 21 of the Publications of the Van Riebeeck Society, Cape Town, vol. 1, 1939, vol. 2, 1940.

Note on Mr. C. R. Seeber.

Gilchrist and Thompson recorded three species: *Labeo seeberi*, *Barbus seeberi*, and *Barbus serra*, collected by "Dr. Seeber" in the "Olifants River." In the case of the first and third species these authors in their monograph place the locality in the Transvaal, but in that of the second species in the Cape Province. In the latter case the locality is still ambiguous because there are two well-known rivers of this name in this Province, one in the Clanwilliam Division, the other in the Oudtshoorn Division (*cf.* p. 119). In the South African Museum Register book, in W. W. Thompson's handwriting, the word "Transvaal" (after Olifants River) occurs only in the case of *Labeo seeberi*, the other two being recorded merely as from the Olifants River.

As it seemed strange that Seeber should have collected in only two rivers, both of the same name, but in two different Provinces, and since it has been found that all the three species in question are common in the Clanwilliam Olifants River, but have not been recorded from any other localities, enquiries were made in likely quarters.

Seeber was evidently in communication with Dr. Gilchrist (see Gilchrist and Thompson, *l.c.*, p. 404), but not with the South African Museum, as his name does not appear on the Museum files.

In the Report of the South African Museum for 1906, however, Dr. Gilchrist recorded the name "C. R. Seeber, Clanwilliam" as a donor of freshwater fishes (Rep. S. Afr. Mus. for 1906, Cape Town, 1907, p. 37).

Consequently it is quite clear: that "Dr." was a misprint for "C. R."; that Seeber obtained all his specimens from the Clanwilliam Olifants River; and that Gilchrist and Thompson inadvertently wrote the word "Transvaal" instead of "Cape" in recording the localities of *Labeo seeberi* and *Barbus serra*.

I have recently (1940) traced and personally met Mr. Seeber. He confirms that the only fishes he sent to Dr. Gilchrist were caught in the Clanwilliam Olifants River, while he was Chief Constable at Clanwilliam.

Note on Krebs.

On one of his expeditions, namely, to Natal and Zululand in 1830, Sir Andrew Smith was accompanied by Krebs (Roberts, Ann. Transv. Mus., xviii, p. 271, 1936), and also by the botanist Drège (Fitzsimons,

ibid., xvii, p. 259, 1937). But I am not aware of any record of Krebs' travels or itinerary.*

The types of *Barbus afer* and *serra* are in the "Krebs collection" now in the Berlin Museum. *B. serra* is a species known only from the Olifants River (Clanwilliam), but *B. afer* has not yet been rediscovered.

Notes on Duplication of Place-names.

Reference has already been made to the ambiguity arising from there being three rivers, two in the Cape Province and one in the Transvaal, bearing the same name of Olifants River (p. 118). Duplication, nay multiplication, of the same place-name occurs with great frequency in South Africa, and the compiler of locality-records should be on his guard.

For the purpose of the present paper the following additional cases may be noted :—

Diep River arising on Table Mt. and flowing into False Bay; Diep River arising near Malmesbury and flowing into Table Bay. In the present paper no reference is made to the Diep River, Caledon, a minor tributary of the Zwart–Bot River.

Gt. Fish River, a *northern* tributary of the Orange River, arising in South West Africa; a large river in the Eastern Cape Province arising on the south of the main Cape watershed; and Fish River, a *southern* tributary of the Orange River connected with the Zak River.

Klip River, Natal (Max Weber), and Klip River, Transvaal (Gilchrist and Thompson).

Palmiet River in the Cape Peninsula, flowing from Table Mt. into Hout Bay; and the Palmiet River (area 5 on map, fig. 1) on the east side of the Hottentots Holland Mts. and Cape Hangklip. There are several other "Palmiet" rivers, or farms called "Palmietrivier."

Similarly there are several Riet, Dwars (or Dwaars), and Zout (or Salt) rivers. There is a Groot (or Groote) River near Ladismith, and one at Steytlerville. Both the Clanwilliam Olifants River and the Oudtshoorn Olifants River have a tributary called the Doorn River. The former of these as well as the Breede River has a tributary, Hex River.

Crocodile River (Transvaal): one of the headwaters (others are the Magalies and Yokeskei rivers) of the Aapies River, arising on

* In a list of donations to the South African Museum in 1825 he was described as "naturalist to His Prussian Majesty." See Kirby, Ann. S. Afr. Mus., xxxvi, p. 14, 1942.

the north of the Witwatersrand in the Krugersdorp and Pretoria Divisions, and belonging to the Limpopo system; a larger river arising on the east of the Drakensberg escarpment in the Lydenburg Division, and joining the Komati River.

In the case of towns, there is Richmond in the Cape Province and in Natal; Heidelberg in the Cape and the Transvaal; Lad*i*smith in the Cape and Lad*y*smith in Natal.

Montagu Pass, north of George, is a long way from the village of Montagu.

Colloquial Names.

As in the case of many other animals, so in the case of fishes, there are very few colloquial names, and these are often applied to several fishes which the scientist now recognizes as distinct species. Consequently they are of little use in scientific work. For example, in the Reports on Inland Waters,* Mr. S. A. Hey employs only colloquial names, and expresses the opinion that "To my mind there is but little, if any, difference between the yellow-fish, scaley, and witte-vis" (Rep., iii, p. 29). Yet his records of the occurrence of these fishes in the various rivers investigated seem to have been based on some character or coloration easily observable in the field (either by himself or his informants), because his records coincide *in general* with the distribution as known from authoritatively identified specimens or recent investigations. *E.g.* Holub's Yellowfish (*B. holubi*) is found (so far as the Cape Province is concerned) in the tributaries of the Orange River (Rep., iii, p. 28), *i.e.* only north of the main Cape watershed.

In detail, however, his records could not be used to delimit the distribution of particular species. These remarks are not intended as criticism, because the Survey was undertaken only with a view "to ascertaining the possibilities of the inland waters of the Union for stocking" with non-indigenous edible fish (Rep., i, p. 1).

In the case of the Kurper, or Rockey as it is known in the Eastern Province, the records show that in all probability *Sandelia* occurs from the Cape along the coastal belt as far as the East London and Komgha districts. When we come to the Transvaal, however, we have to bear in mind that in that part of the country the name Kurper refers to various species of *Tilapia*.

"Rooivlerk Kurper" is a name which, in my own experience, has

* Union S. Afr. Fisheries Survey, Inland Waters, Report, i, 1926; Report, ii, 1926; Report, iii, 1928.

caused confusion owing to the omission of the second word (see pp. 107, 248).

In reports on the Black Bass,* certain statements regarding the local and scientific names, and the distribution, of some of the indigenous fishes are incorrect, though this was unavoidable at the time the reports were written. Later researches have shown, *e.g.*, that the term "rooivlerk" is ambiguous, and that the published records of "*Barbus anoplus*" refer to more than one species, but none of them to the true *anoplus* (p. 206).

"Gillieminkie" is a name applied in the Eastern Province and Natal to any small species of *Barbus* which is not a red-fin. In a MS. note on fishes from the Klip River, Transvaal, the late Dr. Gilchrist spelt the name "Kilimkjas."

Therefore, in order that the various species in the Cape may be referred to with greater exactitude by anglers and others, the following names are proposed. They have been chosen in consultation with Mr. A. C. Harrison, Hon. Secretary of the Cape Piscatorial Society and Advisory Officer on Inland Fisheries to the Cape Provincial Administration.

Labeo capensis	Orange River Sandfish.
,, *umbratus*	Moggel; Mud Mullet (E.P.†).
,, *seeberi*	Clanwilliam Sandfish, Sandvis.
Barbus holubi	Holub's Yellowfish, Geelvis.
,, *capensis*	Clanwilliam Yellowfish, Geelvis.
,, *serra*	Saw-fin.
,, *andrewi*	Andrew Smith's or Cape Whitefish, Witvis.
,, *burchelli*	Burchell's Red-fin, Rooivlerk.
,, *vulneratus*	Castelnau's Red-fin, Rooivlerk.
,, *calidus*	Clanwilliam Red-fin, Rooivlerk.
,, *asper*	Plump Red-fin, Rooivlerk.
,, *tenuis*	Slender Red-fin, Rooivlerk.
,, *senticeps*	Uitenhage Red-fin, Rooivlerk.
,, *pallidus*	Goldie.
,, *karkensis*	Gillieminkie or Gillie (E.P. and Natal).
,, *anoplus* and varieties	Chubby-head (Gouritz, Clanwilliam, Orange River).

* A. C. Harrison, Union S. Afr. Fish. Mar. Biol. Survey, Investigational Reports, 4, 1934, pp. 21, 22, 80; and 7, 1936, pp. 17, 18, 20, 79, 88, 90, 94, 95, 101.

† W.P., E.P. = Western, Eastern Province respectively.

Clarias	. Mud-barbel, Platkop Barber.
Gephyroglanis sclateri . .	. Orange River Rock-baager or Catfish.
„ *gilli* . .	. Clanwilliam Catfish.
Galaxias zebratus . . .	. Mountain Galaxias (W.P.)
„ *punctifer* . .	. Lake or Vlei Galaxias (W.P.).
Sandelia capensis . . .	. Cape Kurper.
„ *bainsii* . . .	. Bain's Kurper, Rockey (E.P.).
Gilchristella aestuarius . .	. Whitebait, Freshwater Sprat.
Mugil	. Springer, Harder.
Anguilla mossambica . .	. Freshwater Eel, Paling.
Monodactylus falciformis .	. Moonfish, Kaapse Nooitje.

Parasites.

Infestation by trematode worms, causing black warts under the scales, may be very heavy in some places, *e.g.* on Red-fins (*Barbus asper*) in a tributary of the Gamtoos River at Patentie. But in most localities the fishes seem to be very free from parasites.

The Fish-louse (*Argulus*) has only been found on *Sandelia capensis* in one locality (see p. 253) in the area dealt with, although Dr. V. Fitzsimons of the Transvaal Museum has submitted specimens from Cichlid hosts from the Transvaal.

Fish-fauna of the River-systems.

The following are not specially listed:—

The Eel (*Anguilla*) is found in all rivers flowing southwards and south-eastwards, *i.e.* in areas 2 and 4–12 (p. 255).

Gobies (*Gobius* and *Psammogobius*) are found in the lower reaches and estuaries of the Breede River and other rivers eastwards (p. 258).

The Moonfish or Kaapse Nooitje (*Monodactylus*) occurs in the Eerste, Breede, and other rivers eastwards.

Springers and Harders (*Mugil*) occur in all estuaries and often for some considerable distance inland (p. 255).

Area on Map, fig. 1.	Rivers and Systems.	Species.	Number of Species.
1	Cape Peninsula and western Cape Flats	*Galaxias zebratus* „ *punctifer* *Sandelia* *Gilchristella*	4

Area on Map, fig. 1.	Rivers and Systems.	Species.	Number of Species.
1A	Diep River, Mosselbank River (Malmesbury district)	*Galaxias punctifer* *Sandelia* [*Tilapia mossambica*, introduced]	2
2	Eerste River	*Galaxias zebratus* ,, *punctifer* *Sandelia* *Barbus burchelli*	4
3	Berg River (Great and Little Berg)	*Galaxias zebratus* ,, *punctifer* *Sandelia* *Barbus andrewi* ,, *burchelli*	5
3A	Zoutkloofs River, Verloren Vlei River, Lange Vlei River	*Galaxias zebratus* ,, *punctifer* *Sandelia*	3
4	Lourens River	*Galaxias zebratus*	1
5	Steenbras River, Palmiet River, Bot River, Onrust to Hermanus streams	*Galaxias zebratus* *Sandelia*	2
6	Hartebeest and Klein River, Zonntagskloof and Uilenkraal rivers, Bushman River	*Galaxias zebratus* *Sandelia* *Gilchristella* (lower reaches, Klein River)	3
7	Breede River, River Zonder End, Buffeljagt River	*Galaxias zebratus* *Sandelia* *Barbus andrewi* ,, *vulneratus* *Gilchristella*	5
7A	Nieuwejaars River, Grashoek River, Kars River (Bredasdorp district)	*Galaxias zebratus* *Sandelia* *Barbus vulneratus* *Gilchristella*	4
7B	Duivenhoks River, Heidelberg, Vette and Kaffirkuils rivers, Riversdale	*Galaxias zebratus* *Sandelia* *Barbus vulneratus*	3
8	Gouritz system: Touws, Buffels, Groote (Ladismith), Dwyka, Gamka, Grobelaars, Le Roux, Olifants (Oudtshoorn); and (south of the Langebergen) Weiders and Valsch rivers	*Galaxias zebratus* *Sandelia* *Labeo umbratus* *Barbus asper* ,, *tenuis* ,, *anoplus*	6
9	Little Brak River, Mossel Bay (upper reaches)	*Galaxias zebratus* *Barbus asper*	2
	Little Brak River and Great Brak River	*Labeo umbratus* (see p. 137)	1
	Malagas River, George	*Galaxias zebratus*	1
	Homteni, Goukama, Kruis River, Knysna; Keurbooms River	*Sandelia* *Barbus asper*	2
10	Groote River, Steytlerville, Baviaans Kloof River, Gamtoos River	*Sandelia* *Labeo umbratus* *Barbus asper* ,, *pallidus*	4

Area on Map, fig. 1.	Rivers and Systems.	Species.	Number of Species.
10A	Kromme River, Geelhoutboom River, Kabeljouw River, Rondebosch River, Zeekoe River, (Humansdorp district)	*Sandelia* *Barbus asper* ,, *pallidus* ,, *senticeps*	4
	van Stadens River	*Sandelia* *Barbus pallidus*	2
11	Baakens and Zwartkops River	*Sandelia* *Barbus pallidus* ,, *senticeps* ,, *asper*? *Gilchristella*	4 or 5
12	Sundays River [not fully investigated]	*Labeo umbratus*	
13	Olifants River, Clanwilliam	*Galaxias zebratus* *Labeo seeberi* *Barbus capensis* ,, *serra* ,, *calidus* ,, *phlegethon* ,, *cernuus* *Gephyroglanis gilli*	8
14	Orange River, western or lower section, below Aughrabies Falls, incl. Gr. Fish River (S.W.A.)	*Labeo capensis* *Barbus holubi* ,, *paludinosus* ,, *hospes* *Engraulicypris gariepinus* *Clarias gariepinus*	6
14A	Orange River, middle section from Aughrabies Falls to junction of Caledon River, incl. southern tributaries Great Riet, Zak, Ongars, etc. (excl. Dry Hartz, Vaal, Modder, and other northern tributaries)	*Labeo capensis* ,, *umbratus* *Barbus holubi* ,, *paludinosus* ,, *anoplus* var. *Gephyroglanis sclateri* *Clarias gariepinus*	7

Family CYPRINIDAE.

Gen. Labeo Cuv.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, pp. 346, 553, 562.

Historical (excluding Transvaal and Rhodesian species).

1841. Andrew Smith described and figured:

Abrostomus umbratus from rivers north of the Orange River, with "very small" scales (actual number not stated, but figure shows at least 110 along lateral line); and *A. capensis* from rivers of Cape Colony [*i.e.* south of the Orange River] but without definite locality, with "rather small" scales (figure shows about 60 in lat. line).

Such an enormous number of scales as is represented in the figure of *umbratus* is unknown in the genus; the nearest approach being 82–90 in *seeberi*. It is possible that Andrew Smith did actually obtain a specimen of the Olifants River (Clanwilliam) species together with specimens of *Barbus capensis* (p. 116, footnote); but both *umbratus* and *capensis* are stated to have two pairs of barbels, which *seeberi* (adult) has not got. On the other hand, as noted above (p. 115) the artist responsible for Smith's figures persistently represented more scales than were necessary.

We may therefore regard Smith's figures of *umbratus* and *capensis* as representing two species, one with relatively smaller and one with relatively larger scales. Although there may be a suspicion that *umbratus* was based on (or perhaps partly based on) a specimen of what we now know as *seeberi*, there is no means of proving it; and we must accept Boulenger's diagnoses based on specimens in the British Museum.

1861. Castelnau described inadequately:

Labeo cafer from Cat River (Gt. Fish River), and *L. sicheli* from "la partie supérieure de la rivière d'Orange"; the latter is stated to have about 60 scales in the lateral line and "D 3/9." He also recorded *A. capensis* Smth. from Burghersdorp (Orange system).

1868. Günther (Cat. Fish. Brit. Mus., vii, p. 68) abstracted brief diagnoses of Smith's two species, but mentioned no specimens in the British Museum or elsewhere. We may assume that Smith's types were, even then, lost or not available.

1894. Steindachner described and figured:

A. capensis Smith, from Philippolis, O.F.S., with 59–60 scales in the lat. line; and *L. tenuirostris* from the Limpopo River, with 46 scales in the lat. line.

1909. Boulenger made no reference to Smith's types, and appears to have recognized that the artist exaggerated the number of scales in the figures. He therefore based his descriptions on more recent material, and defined:

L. umbratus (Smith) as having 58–65 scales in the lat. line, 30–34 around caudal peduncle, dorsal rays 8–10, and anal not reaching caudal.

L. capensis (Smith) as having 44–50 scales in the lat. line, 20–24 around caudal peduncle, dorsal rays 10–11, and anal reaching to caudal (or nearly).

He made *cafer* Cast. and *sicheli* Cast. synonyms of *umbratus* (Smith) Blgr., and in accordance with his interpretation of Smith's species transferred *capensis* of Steindachner to *umbratus*, and *tenuirostris* Stndnr. to *capensis* (Smith).

The British Museum material listed by Boulenger constitutes the plesiotypes of the two species, the authorship of which should be credited to Boulenger as well as to Smith.

It cannot be maintained that Steindachner in assigning a specimen, described in detail by him, to *capensis* thereby crystallized the diagnosis of this species. Smith's two species must be taken *in conjunction*, and as Steindachner's specimen has the smaller scales it is rightly regarded as a synonym of *umbratus*. His figure shows well the plump head (see fig. 3, *a*) and the short anal fin.

1911. Gilchrist and Thompson described (not figured until 1913):

L. seeberi from "Olifants River, Transvaal" (see p. 118), with 83 scales in lat. line, and "about 32" (actually 48) around the caudal peduncle.

1913. The same authors followed Boulenger as regards the diagnoses of Smith's two species, and accepted his synonymy. In addition they described and figured:

L. stenningi from Potchefstroom (Vaal–Orange system), with 60 scales in lat. line, and 28 around caudal peduncle. The single specimen has actually 30 scales around caudal peduncle, and 4 dorsal spines (as in many specimens of *umbratus*, though the 1st is very small and inconspicuous). I am unable to accept it as a valid species, and include it under *umbratus*, with which it further agrees in the shape of the head and the position of the barbels.

L. rubromaculatus from Zululand (Tugela River system), with 43 scales in lat. line, and 20 [22] around caudal peduncle. Besides the type (total length 270 mm.) there is in the South African Museum a series of 14 specimens, 120–190 mm. in length, from the same locality. The type has D iii. 9, one other has iii. 10, all the others have iv. 9, although the 1st spine is very inconspicuous. Red spots may occur also in *capensis* (p. 133).

1916. Boulenger accepted *stenningi* and *rubromaculatus* as valid species, the former without comment, the latter with the remark that it was very close to *capensis*.

1938. A peculiar little (90 mm.) species, *L. quathlambae* Brnrd., was described (Barnard, 1938, Ann. Natal Mus., viii, p. 526, text-fig.) from Natal. Apparently allied to *umbratus*.

Key to the Cape Species.

1. Two barbels on each side (fig. 3, *a*, *b*). Scales moderate.
   a. Scales l.l. 43–50, c.ped. 20–24. Dorsal branched rays usually 11. Anal reaching to caudal (or nearly) . . . . *capensis*.
   b. Scales l.l. 57–65, c.ped. 30–34. Dorsal rays usually 9. Anal not reaching caudal . . . . . *umbratus*.
2. No barbels (in adult) (fig. 3, *c*). Scales very small, very numerous, l.l. 82–90. Dorsal rays usually 9. Anal not reaching caudal . *seeberi*.

Distribution (fig. 2).

L. capensis. Although Andrew Smith stated that this species was found in Cape Colony [*i.e.* south of the Orange River], published records and material in the South African Museum indicate that it occurs in the Vaal–Orange system north of the main Cape watershed, but not south of this watershed. In an Albany Museum Guidebook (*l.c.*, *infra*, 1937, p. 129) it is recorded that "when the Gt. Fish River [*i.e.* the one in the Eastern Province] comes down in flood many thousands of this species are thrown up on the shore near the mouth of the river." But Dr. J. L. B. Smith, who compiled the list, tells me (*in litt.* 21/v/41), when I pointed out that the occurrence of this species in this river seemed to be an anomaly, that the paragraph in question was intended to apply to *umbratus*.

Gilchrist and Thompson record a specimen from the Crocodile River (? which one, see p. 119), Transvaal; and *tenuirostris* came from the Limpopo River. The former specimen is supposed to be in the Transvaal Museum. I have not seen it; but I have seen another specimen from the Crocodile River, Pretoria district (caught 3/x/13).* This latter specimen, like *tenuirostris*, shows slightly different proportions (larger eye) from those of the Vaal–Orange series of *capensis*, as may be seen from the table. Whether this feature is constant and definite enough to justify resurrecting *tenuirostris* remains to be tested on a long series from the Limpopo system.

The Pretoria Crocodile River rises on the north of the Witwatersrand, not far from some of the headwaters of the Vaal system, but flows northwards to join the Aapies River (Limpopo system).

In the Tugela River system occurs *L. rubromaculatus*, a species exceedingly close to, if not identical with, *capensis*.

For the present I do not include *tenuirostris* or *rubromaculatus* in the synonymy of *capensis*.

* Thanks to the kindness of the Director and Dr. V. Fitzsimons.

FIG. 2.—Distribution of *Labeo* in Southern Africa.

■ *seeberi*. △ *umbratus*.
○ *capensis*. ○ *rubromaculatus*.
● *tenuirostris*. + *quathlambae*.

L. umbratus was recorded by Andrew Smith from streams north of the Orange River, but most later records are from the southern tributaries of the Orange and localities south of the main Cape watershed: the exceptions being Castelnau's *sicheli*, Boulenger's record from Vredefort, O.F.S. (from a tributary of the Vaal River), the type of *stenningi* from Potchefstroom; and half a dozen other specimens (South African and Kimberley Museums) from the Modder River at Glen, O.F.S., and Vryburg, Bechuanaland; also from a tributary of the Zand River near Whites (20 miles south of Kronstad).

It occurs as far west as the Gouritz River system; it has been collected in the Gamtoos River, and is reported from the Sundays River and the Gt. Fish River, but not from the Gt. Kei River or farther east.

The limits of distribution of these two species requires to be worked out in much greater detail.

L. quathlambae occurs in the Upper Umkomazana River (Umzimkulu River system) near Himeville, Natal.

L. seeberi. Evidence has been given above (p. 118) showing that the original specimen came from the Clanwilliam Olifants River, from which river alone all recent specimens have been obtained.

Taxonomic Characters.

Dorsal Fin Spines.—In the three Cape species 4 dorsal spines can usually be seen without difficulty in the juveniles; but the 1st spine is very small and in half-grown and adults is usually obscured under the skin and last predorsal scale (cf. *Barbus, infra*, p. 142).

Anal Fin.—No marked growth-change in shape occurs. The fin has the shape seen in certain species of *Barbus* (e.g. *holubi, q.v.*), characterized by the apex of the 1st branched ray reaching beyond that of the last ray when laid back. The tip of the fin (as also of the ventral fins) may be somewhat bluntened in large specimens. The extent to which the tip of the fin (1st ray) reaches along the caudal peduncle appears to have some specific value, at least in the Cape species. Juveniles (30 mm.) of *capensis* can be distinguished easily from those of *umbratus* by this character alone.

Pectoral Fin.—No growth-change or sexual difference has been observed in the three species examined.

Scales.—The striae are subparallel, or very slightly radiating. No appreciable difference in the number of striae occurs in the three Cape species.

Mottley (Fishing Gazette, cxv, no. 3155, Oct. 1937, p. 444) shows that the difference in the number of scales in North American trout, hitherto regarded as a specific character, is dependent on the temperature at the eyed-egg stage and for five weeks thereafter: the higher the temperature, the lower the scale-count. The quoting of this reference must not be taken to imply that a similar phenomenon may have occurred in the genus *Labeo*, leading to the differentiation of such a form as *seeberi*. In comparison with the more tropical species, *seeberi* has a remarkably high scale-count. But we have no very definite data on the spawning season or seasons, and none on the concomitant water-temperature factors, of any of the South African species. A very cursory plotting of localities of the species, and the *air* temperatures of the nearest recorded meteorological station (Union of South Africa Year Book), seems to show that such an investigation *might possibly* prove interesting.

Warts on Head.—Many of the species of this genus, e.g. *cylindricus*, develop conspicuous horny tubercles on the snout in the adults of both sexes, though they are often better developed or more numerous in males than in females. These warts are perhaps caducous after the actual spawning period, leaving crater-like scars.

The Cape species *capensis*, *umbratus*, and *seeberi* do not develop these horny warts; nor does *rubromaculatus* (in the material at hand).

On the other hand, it seems to be a property of the mucous covering on the head and body, both in those species which develop large warts and in those which do not, to show when preserved a large number of minute whitish pimples. They are often indistinct, and the variability in this respect seems dependent on the method or state of preservation. Sometimes they are so numerous as to lead one to suppose they might be sexual or even specific; but they are not so, as their occurrence has been noted in both sexes of both "tuberculate" and non-tuberculate species. In fact they can be seen sometimes in the mucus on the scales, especially on the back and shoulders, but not of course if the specimen has been wiped clean.

Macrocephaly.—Specimens of both *capensis* and *umbratus* are occasionally found with an abnormally large head, so to speak a "bull-head": see the 300 mm. Laingsburg and the 240 mm. Keiskama specimens in the table of measurements for *umbratus*.

Labeo capensis (A. Smith) Blgr.

Orange River Sandfish.

Figs. 3, *b*, 4.

1841. A. Smith, Illustr. Zool. S. Afr. Pisces, pl. 12, fig. 2.
1861. Castelnau, Mem. Poiss. l'Afr. austr., p. 57 (name only).
1909. Boulenger, Cat. Fw. Fish. Afr., i, p. 340.
1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 360.
1937. J. L. B. Smith, Guide Vert. Fauna East. Prov., Albany Mus., Grahamstown, pt. 2, p. 128, pl. 31, fig. 3.

(The figures in Boulenger, G. and T., and J. L. B. Smith are of *tenuirostris*, after Steindachner.)

[Not *capensis* Steindachner, 1894.]

In addition to the diagnostic characters in the key, the following may be given: nape, especially in mature examples, rising in a sharp curve; lower profile of head flat; snout as long as or slightly longer than postocular part of head; rostral flap well developed; distance between bases of anterior barbels about 2 in snout and subequal to distance between bases of the anterior and posterior barbels; posterior nostril oval or subcircular, closed by a rather large flap (easily overlapping the rim of the nostril in well-preserved specimens).

The growth-changes may be illustrated by the following table compiled from two long series of specimens: one from the Modder River (Kimberley district), the other from Goodhouse on the Orange River and Aiais on the Great Fish River (S.W.A.) *; measurements of a few larger specimens from other localities (including the largest in the S.A. Mus.) are included.

The two series are very similar. In the largest Aiais specimens (2 each of 170 and 190 mm.) the head is proportionately larger than might be expected (*cf.* also *L. umbratus*).

In the smallest example (16 mm.) only the posterior barbel is present (fig. 4); but at 18 mm. the first indication of the anterior barbel is distinguishable. At this stage also the lips are already thick and papillose.

The scales are developed between the 22 and 25 mm. stages. Large specimens show granular roughening on the shoulder and nape scales.

At about 60–65 mm. minute whitish granules or pimples can be noticed in the mucus on the top of the head and snout, extending down the sides of the latter, but not strong hard warts as in *cylindricus*,

* See note, p. 119.

rubropunctatus, etc. These pimples continue throughout life, being present in the largest specimens, and in both sexes (see p. 130).

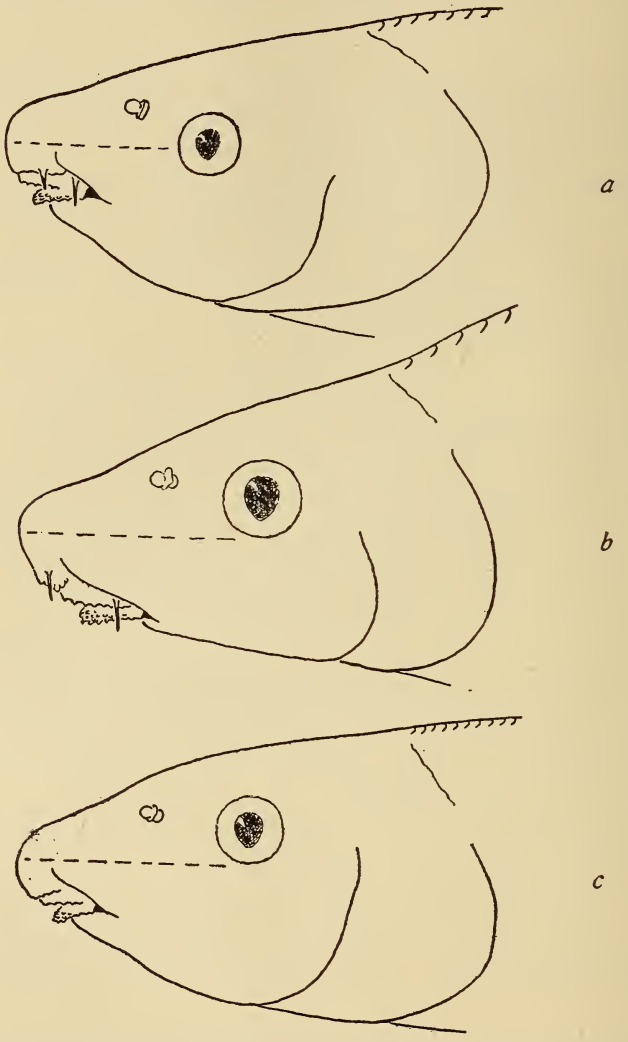


Fig. 3.—*Labeo.* Semidiagrammatic outlines of heads of half-grown specimens (150–200 mm.). Anterior predorsal scales indicated. Line from middle of snout to indicate relative position of eye.
a. umbratus. *b. capensis.* *c. seeberi.*

The smallest ovigerous ♀ measures 200 mm. in length (Zak River, Fraserburg).

Young specimens 21–25 mm. in length are easily distinguished from young *Barbus holubi* of same size (in addition to morphological characters) by a heavier pigmentation. All the specimens obtained from the Great Fish and Orange rivers had numerous minute dots on the scales over the whole body except those on the throat and ventral portion of the belly. Two of the larger ones had several dull reddish, round spots irregularly and asymmetrically arranged on the sides; according to the collectors these spots were not noticeable when the fishes were caught (cf. *rubromaculatus* G. and T., p. 360).*

No records of time of spawning are available. The Aiais and Goodhouse series, including juveniles from 16 mm. upwards, were collected early in November (1936).

Localities.—Orange River system: lower Orange (below Aughrabies Falls) and its tributary Gt. Fish River (coll. C. W. T. and A. J. H.); middle Orange (between Aughrabies Falls and junction with Caledon River) at Prieska and above the Aughrabies Falls (S. Afr. Mus.), Zak River, Fraserburg (Boulenger, G. and T.); upper Orange at Burghersdorp (Castelnau), Aliwal North (S. Afr. Mus.), Stormberg River north of Burghersdorp (coll. C. W. T. and L. D. B.).

Vaal and northern tributaries: Dry Hartz at Taungs (coll. C. W. T. and L. D. B.), Kimberley † (Boulenger, G. and T.), Warrenton (coll. C. W. T. and L. D. B.), Potchefstroom (Boulenger, G. and T.),

* Sir J. E. Alexander, "An Expedition of Discovery into the Interior of Africa" (London, 1838), vol. 2, p. 204: "Among other fish caught here [in the Gt. Fish River at Kuis, near Kub, north of Gibeon] were two which seemed to be novel: one, eighteen inches long, was brown on the back, with *red blotches on the sides* [italics mine], and yellowish-white belly; it had a purse or bag-like mouth, and eleven rays to the dorsal fin, was evidently a barbel (*barbus*), but peculiar from having its nose produced and rounded, like *Cyprinus Narus*, and from the form of the back being elevated and rounded.

"The other was a foot long; its back was bluish, | p. 205, yellowish on the sides; it was probably a Leuciseus [*sic*], for there were no indications of beards. Mr. J. E. Gray, of the British Museum, to whom my sketches were shown, proposed to call the first of these two varieties of fish *Barbus Namaquaensis*, and of the second he said that he was not aware that any species of the genus, to which it appeared to belong, had before been recorded as a native of the southern part of Africa."

The first fish is clearly *Labeo capensis*. Gray's name was never published, and though we must credit Andrew Smith with knowing Alexander's work, it is doubtful whether he would have recognized either his *capensis* or *umbratus* in a fish stated to have red blotches on the sides.

The second fish would seem to be *Barbus holubi*, though Alexander said it had no barbels, and made no mention of the characteristic stout dorsal spine; but there is no other species of that size.

† See note on Kimberley Reservoir under *Barbus kimberleyensis*, p. 159.

Labeo capensis.

TL in mm.	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	barb.	Sex and Remarks.
Goodhouse (16–40 mm.) and Aiais (21–190 mm.).									
16	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales		Very feeble	p.	D iv. 11, fin rays distinct.
18	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales			p.(a)	
20	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales			p.a.	Lips thick and sub-papillose.
22	$3\frac{1}{4}$	$3\frac{1}{4}$	1	$1\frac{1}{4}$	No scales			p.a.	
25	$3\frac{1}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	43	20	3+14		
28–30	$3\frac{1}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	42–43	20	5+17		
32–34	$3\frac{1}{4}$	$3\frac{1}{3}$	$1–1\frac{1}{5}$	$1\frac{1}{4}–1\frac{1}{3}$	,,	,,			
36	$3\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	,,	,,			
40	$3\frac{1}{4}–3\frac{1}{3}$	$3\frac{1}{2}$	$1\frac{1}{4}–1\frac{1}{3}$	$1\frac{1}{2}$	,,	,,			
45	$3\frac{1}{2}$	$3\frac{3}{4}$	$1\frac{1}{4}–1\frac{1}{3}$	$1\frac{1}{2}$	43–44	,,	6+20		
50–55	$3\frac{1}{2}–3\frac{2}{3}$	$4–4\frac{1}{3}$	$1\frac{1}{2}–1\frac{3}{4}$	$1\frac{1}{2}–1\frac{3}{4}$	43–45	20–22			
60–65	$3\frac{2}{3}–3\frac{3}{4}$	$4\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{3}{4}$	,,	22			
70–75	$3\frac{3}{4}–4$	$4\frac{1}{2}$	2	2	44–46	,,			
80–85	,,	,,	,,	,,	,,	,,			
90	,,	,,	,,	,,	,,	,,	10+26		
110	4	5	2	$2\frac{1}{4}$	,,	,,			
160	$4–4\frac{1}{5}$	$5\frac{1}{3}–5\frac{1}{2}$	$2\frac{1}{4}$	3	45–46	,,			
170	$4\frac{1}{4}–4\frac{1}{3}$	$5\frac{1}{2}$	$2\frac{1}{4}$	3	,,	,,			
190	$4\frac{1}{3}$	$5\frac{1}{2}–5\frac{3}{4}$	,,	,,	,,	,,	12+30		
Modder R., south of Kimberley.									
28–30	$3\frac{1}{4}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	43–44	20	5+16	p.a.	
35	$3\frac{1}{4}–3\frac{1}{3}$	$3\frac{1}{3}–3\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{3}–1\frac{1}{2}$	,,	,,			
40–45	$3\frac{1}{3}–3\frac{1}{2}$	$3\frac{2}{3}–3\frac{3}{4}$	$1\frac{1}{3}–1\frac{1}{2}$	$1\frac{1}{2}–1\frac{3}{4}$	,,	,,			
50	$3\frac{1}{3}–3\frac{2}{3}$	4	$1\frac{1}{2}$	$1\frac{3}{4}$	,,	,,	7+20		
60	$3\frac{2}{3}$	$4\frac{1}{3}–4\frac{1}{2}$	$1\frac{3}{4}$	2	43–45	22			
70	$3\frac{4}{5}$	$4\frac{1}{3}$	$1\frac{4}{5}$	2	,,	,,			
80	4	$4\frac{1}{2}$	2	2	,,	,,			
90	4	$4\frac{1}{2}$	2	2	,,	,,	10+26		
98	4	5	2	2	,,	,,			
Prieska, 115	$4\frac{1}{5}$	6	$2\frac{1}{2}$	3	44	22			
Zak R., 200	$4\frac{1}{2}$	$6\frac{1}{5}$	$2\frac{3}{4}$	3	45	,,	..	..	♂, ovig. ♀.
Vaal R., 215	$4\frac{1}{2}$	6	$2\frac{3}{4}$	3	46	,,			
Potchefstroom, 255	$4\frac{2}{3}$	6	$2\frac{3}{4}$	3	44	,,			
Modder R., Glen, O.F.S., 260–270	$4\frac{1}{2}$	$7–7\frac{1}{2}$	3	$3\frac{1}{3}$	44–45	,,		..	♂♂.
Limpopo R., 260	$4\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{1}{2}$	$(2\frac{3}{4})$	46	(22)		..	*tenuirostris* Stndnr.
Aliwal N., 325	$4\frac{1}{2}$	$8\frac{1}{2}$	4	$4\frac{1}{2}$	47	22	12+38		
Crocodile R., Pretoria, 340	$4\frac{2}{3}$	7	$3\frac{1}{4}$	4	43	20	..	..	♂ (Pretoria Mus.).
Modder R., 350	$4\frac{2}{3}$	$8\frac{1}{2}$	4	$4\frac{1}{2}$	45	22	..	..	Ovig. ♀.
Zak R., 450	$4\frac{3}{4}$	9	$4\frac{1}{3}$	5	46	,,	..	..	Ovig. ♀.

Vredefort Road (Boulenger), Modder River, south of Kimberley (G. and T.), 25 miles north of Bloemfontein (coll. C. W. T. and L. D. B.), Glen (S. Afr. Mus.), Kromspruit, 38 miles south of Bloemfontein (coll. C. W. T. and L. D. B.).

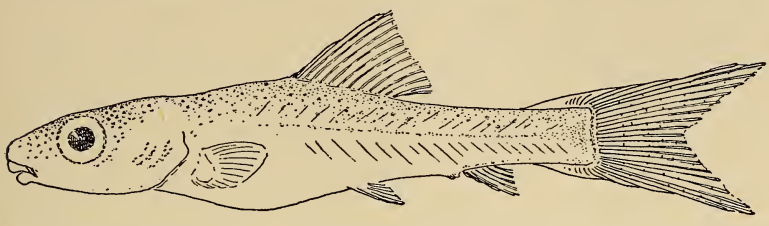


Fig. 4.—*Labeo capensis.* Juvenile, 16 mm. Goodhouse, Orange River.

Records from the Transvaal (Crocodile and Limpopo rivers) are not included above, as the status of *tenuirostris* should be investigated more closely.

Labeo rubromaculatus.

For comparison with *L. capensis.*

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	Sex and Remarks.
M'fongosi, Zululand.	120	4	4⅖	2	2¾	44	22	10+28	
	130	4	5	2	3	,,	,,		
	140	4	5	2	3	,,	,,		
	150	4¼	5½	2½	3½	,,	,,		
	160	4⅓	5½	2½	3½	,,	,,		
	170	4½	5¾	2¾	3½	,,	,,		
	180	4½	6	3	4	,,	,,		
	190	4½	6	3	4	43	20		
	270	4¾	6½	3	4	,,	22	12+36	♂ Type D iii, 9.

13 specimens D iv. 9, one (160 mm.) D iii. 10.

Labeo umbratus (A. Smith) Blgr.

Moggel; Gamkavis; Vaalvis; Mud Mullet.

Fig. 3, *a*.

1841. A. Smith, *l.c.*, pl. 12, fig. 1.

1861. Castelnau, *l.c.*, p. 60 (*cafer* and *sicheli*).

1894. Steindachner, Sb. Ak. Wiss. Wien, ciii, p. 12, pl. 4, fig. 1, 1 *b* (*capensis* non Smith).

1909. Boulenger, *l.c.*, p. 339, fig. 255.

1913. Gilchrist and Thompson, *l.c.*, p. 362, fig. 30 (after Blgr.).

1913. *Id.*, *ibid.*, p. 363, fig. 31 (*stenningi*).

1916. Boulenger, *l.c.*, iv, p. 208, fig. 131 (after G. and T.) (*stenningi*).

1937. J. L. B. Smith, *l.c.*, p. 129, pl. 31, fig. 4 (after Boulenger).

Characters additional to those given in the key: nape not rising; lower part of head swollen, profile convex (this is well shown in Steindachner's figure; Andrew Smith's figure is not drawn in true side-view and shows the broad snout); snout shorter than postocular part of head; rostral flap feebly developed; distance between bases of anterior barbels 1½ in snout, and 2–2½ times as great as the distance between bases of anterior and posterior barbels; posterior nostril narrow oblong-crescentic, the flap just large enough to close the aperture.

The usual dorsal fin formula is D iii. 9; the true 1st spine is very small and mostly obscured in half-grown and adult specimens, but juveniles show 4 distinct spines. Occasionally specimens with D iv. 8 or D iv. 10 are found (Zak River, 44 with 9 rays, 3 with 10).

The anal fin is shorter than in *capensis*, not reaching beyond about half-way along the caudal peduncle.

The table seems to show that in addition to these differences this species has a smaller eye relatively to the length of the head.

Like *capensis*, the young have the scales heavily dotted with dark pigment. The colour in life is silvery, greyish or greenish-grey or buff on back, fins with a faint pink tinge.

It appears to start breeding at about the same size as *capensis*. The largest recorded size is 310 mm. (Boulenger). The earliest stages have not yet been obtained. Ripe adults were obtained in middle and late October (1937), as were also the 30 mm. and other juveniles listed in the table. Information received from Cradock by the Department of Agriculture of the Cape of Good Hope in 1894, stated that these fish spawned in September; and it was suggested that the close season should be from September to November.

No large warts on head in either sex.

Variability is shown in the three specimens from the Keiskama River. Normally the distance between tip of snout and origin of dorsal fin is greater than distance between base of last dorsal ray and end of scaling on caudal peduncle. The 240-mm. specimen is normal in this respect, but in the 210-mm. specimen the two distances are equal; and the 230-mm. specimen is intermediate.

Localities.—Gouritz River and tributaries—Touws River; Buffels River (Laingsburg); Gamka River (Prince Albert); Buffels or Groot River (Ladismith); Valsch River (Albertinia); Olifants River

Labeo umbratus.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	barb.	Sex and Remarks.
Gamka Poort, Ladismith.	30	$3\frac{2}{3}$	$3\frac{1}{3}$	1	$1\frac{1}{2}$	53	26	3+15	p (a)	D iv. 9.
	35	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	57	28	4+18	p (a)	Lips papillose.
	40	$3\frac{3}{4}$	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{2}$	57–58	28–30	..	p.a.	
	45	$3\frac{3}{4}$	4	$1\frac{1}{3}$–$1\frac{1}{2}$	$1\frac{3}{4}$	,,	,,	5+20	p.a.	
	55	$3\frac{4}{5}$	4	$1\frac{1}{3}$–$1\frac{1}{2}$	$1\frac{3}{4}$–2	56–58	,,	5–6+20		
	65	4	$4\frac{1}{3}$	$1\frac{1}{2}$–$1\frac{2}{3}$	$2\frac{1}{3}$	58–61	30–32	6–7+23		
Buffels R., Laingsburg.	75	4	$4\frac{1}{2}$	$1\frac{2}{3}$	$2\frac{1}{2}$	,,	,,			
	85	4	5–$5\frac{1}{4}$	2	$2\frac{3}{4}$–3	60–62	32			
	95	4	$5\frac{1}{2}$	2	$3\frac{1}{3}$	,,	32–34			
	100	4	$5\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{1}{2}$	58-60	32	8+25		
	135	4–$4\frac{1}{4}$	6	$2\frac{1}{3}$	$3\frac{3}{4}$	59–64	32–34			
	145	4–$4\frac{1}{4}$	6	$2\frac{1}{3}$	$3\frac{3}{4}$	59–62	32			
	160	4–$4\frac{1}{4}$	6–$6\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{3}{4}$–4	59–60	32	..	..	♂♂ immature and ripe.
	170	$4\frac{1}{4}$	$6\frac{1}{2}$	$2\frac{1}{2}$	4	57	32	9–10+30	..	♂.
	180	4–$4\frac{1}{4}$	$6\frac{3}{4}$–7	$2\frac{1}{2}$	4–$4\frac{1}{4}$	59–65	32–34	..	..	♂♂, ♀♀.
	210	4–$4\frac{1}{4}$	7	$2\frac{1}{2}$–$2\frac{3}{4}$	$4\frac{1}{3}$	58–61	,,	10+32	..	♂, ovig. ♀.
	230	$4\frac{1}{4}$	7	$2\frac{3}{4}$	$4\frac{1}{3}$	56	34	..	..	,,
	240	$4\frac{1}{4}$–$4\frac{1}{3}$	7–$7\frac{1}{4}$	$2\frac{3}{4}$–3	$4\frac{1}{2}$	60–63	32	..	..	,,
	270	$4\frac{1}{3}$	$7\frac{1}{3}$	3	5	68	,,	..	..	Ovig. ♀.
	290	$4\frac{1}{3}$	8	3	5	61	,,	..	..	♂, ovig. ♀.
	300	4	9	$3\frac{1}{2}$	5	54	30	..	..	Ovig. ♀.
Keiskama R., Alice.	210	4	$7\frac{1}{4}$	$2\frac{3}{4}$	$4\frac{1}{3}$	60	30	10+32	..	♂.
	230	4	8	3	$4\frac{1}{2}$	62	32	..	..	Ovig. ♂.
	240	$3\frac{1}{2}$	9	$3\frac{1}{2}$	5	61	30	12+30	..	♂.
	205	$4\frac{1}{4}$	$6\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{4}{5}$	60	30	10+30		♀ Type *stenningi*.

(Oudtshoorn) (the last-mentioned according to Mr. Pocock of Oudtshoorn, all the former collected by K. H. B., C. W. T., and A. J. H., 1937); Grobelaars River (Oudtshoorn) and Gamka River (Boulenger, Gilchrist and Thompson).

Little Brak River and Great Brak River—a MS. note by the late Dr. Gilchrist refers to specimens from these rivers sent to the S. Afr. Museum and identified by Mr. Trimen (date ?. Mr Trimen ceased to be Director in 1895).

Gamtoos River—upper reaches (=Groote River) at Fullarton and Steytlerville; lower reaches at Patentie (coll. K. H. B., C. W. T., and A. J. H., 1938).

Sundays River—Van Ryneveld's Pass Dam, Graaff-Reinet (A. C.

Harrison in F. Mar. Biol. Surv., Investigat. Rep., 7, 1936, p. 75, specimens not seen by me).

Gt. Fish River—Cradock (Boulenger); Fort Brown, Albany Div. (Grahamstown Museum, seen by me); Tyumi River, tributary of Keiskama River, Alice (Gilchrist and Thompson). Also Cat River (a tributary) if Castelnau's *cafer* be regarded as synonymous.

Orange River—streams N. of Orange River (A. Smith); upper Orange (Castelnau, *sicheli*); Philippolis (Steindachner); tributary of Zand River at Whites, approx. 20 miles south-west of Kronstad (coll. D. Hey, Jonkershoek Fish Hatchery, seen by me); tributary of Vaal River at Vredefort Road (Boulenger); Potchefstroom (Gilchrist and Thompson, *stenningi*); Vryburg (S. Afr. Mus., Kimberley Mus.); Zak River, Williston, and Ongar River, Richmond (Cape) (coll. K. H. B., C. W. T., and L. D. B., 1939); Modder River at Glen (S. Afr. Mus.); Sea Cow (Seekoe) River, 8 miles N.E. of Hanover, Oorlogspoort River, 20 miles S.E. of Colesberg, and Stormberg River, 11 miles N. of Burghersdorp (all coll. C. W. T., L. D. B., A. J. H., 1939).

Labeo seeberi G. and T.

Clanwilliam Sandfish.

Fig. 3, *c*.

1911. Gilchrist and Thompson, Ann. Mag. Nat. Hist. (8), vii, p. 477.

1913. *Id.*, Ann. S. Afr. Mus., xi, p. 347, fig. 18.

1916. Boulenger, Fw. Fish. Africa, iv, p. 211, fig. 133.

The following description is supplemental to that of Gilchrist and Thompson:—

Depth $4\frac{1}{2}$ (juv. and the type) to $4\frac{3}{4}$ (largest specimen), length of head 4 (70 mm.) to $5\frac{1}{4}$ (largest specimen) in length of body, excluding caudal fin. Interorbital width twice in length of head (slightly more than twice in smallest specimen). Snout subequal to postocular part of head in juv. up to 96 mm., longer in specimens of 185 mm. and upwards. Eye $3\frac{3}{4}$ (70 mm.) to 7 (the type, and 280 and 380 mm.) in length of head. (Measurements involving the length of the head are dependent somewhat on the method of preservation, as the tip of the snout is very fleshy.)

A low fleshy ridge runs obliquely from the origin of the rostral flap towards the junction of the upper and lower lips, and ends in a very small barbel ($\frac{1}{5}$ eye diameter) on the left side in one 83-mm. specimen, on both sides in one 93-mm. specimen; in all other specimens the

ridge ends bluntly; both ridge and barbel (when present) are hidden under the preocular margin when the mouth is closed.

Posterior nostril oval or subcircular, the flap just closing the aperture.

In all specimens up to 280 mm. (including the type), distance between *nostril* and base of 3rd dorsal spine subequal to distance between base of last dorsal ray and base of median caudal rays; in the largest specimen the latter distance is subequal to that between *tip of snout* and base of 3rd dorsal spine. In all cases base of ventral spine vertically below base of 4th or 5th dorsal ray.

D iv. 9 (–10). Pectoral $\frac{2}{3}$ (juv.)–$\frac{4}{5}$ length of head. The type has the lower caudal lobe longer than the upper (as G. and T. describe, though the figure scarcely shows it), but this seems to be merely casual, as the other specimens have the upper lobe slightly longer than the lower. Anal fin not reaching lower caudal rays. Caudal peduncle twice as long as deep in juv. and type, nearly $2\frac{1}{2}$ as long as deep in the 280-mm. specimen, and nearly 3 times in the 380-mm. specimen.

Scales: l.l. 82–87, the largest specimen 90; between l.l. and ventral spine 16; around caudal peduncle 36 (juv.) increasing to 50 (the type has 48).

Gill-rakers on 1st arch: 7 (upper part) + 24 (lower part) (72 mm.), increasing with age to 14 + 40.

Stomach-contents, all ages, fine vegetable debris and microscopic algal growths.

Pale grey or brown with silvery sheen, belly silvery white, each scale (not the body as in G. and T.'s account) on back and sides with minute dark dots, more noticeable in juveniles than adults.

Locality.—Olifants River, Clanwilliam, Cape.

Remarks.—This species is more slender than either *capensis* or *umbratus*. Even ripe females in good condition are scarcely so plump as the type; and none have the arched dorsal profile shown in the figure, which is due to the position in which the specimen has been preserved; also the artist has "improved" the profile of the belly, giving an unnatural depth of body. In the largest specimen the slenderness, especially of the hinder part of the body and of the caudal peduncle, is very noticeable.

Of 50 specimens netted in mid-April 1937, ranging from about 150–290 mm., there were 6 ♂♂ and 7 ♀♀ apparently nearly ripe, and 37 immature; the mature ones were 250 mm. upwards in length. Six specimens had 10 dorsal rays. No strong warts on head in either sex.

The young stages have not yet been obtained (see *infra*).

Mr. A. C. Harrison has kept a small specimen, 4½–5 in. long, in captivity for four years. Although it fed well on algae, etc., it did not increase in size.

Labeo seeberi.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	g.r.	barb.	Sex and Remarks.
70	4	3¾	1½	1½	82	36	7+24		
75	4	4	1⅔	1¾	83	38	8+25		
80	4¼	4¼	1¾	2	83	38	8+25	p.	
90	4¼	4½	1¾	2	86	38	..	p.	
95	4¼	5	2¼	2¾	85	40	8+25		
110	4⅓	5	2¼	2¾	85	40	9+25		
140	4⅓	5¼	2½	2⅘	86	42	10+26		
175	4½	5½	2⅔	3	84	44	11+28		
185	4½	5½	2⅔	3	87	46	12+30		
210	4½	6	2⅔	3	84	48	12+33		
268	4½	7	3	3½	85	48	14+38		Type.
275	4⅔	7	3	3½	85	48	14+40		
280	4¾	7	3	3½	83	48	,,		
290	4¾	7	3	3½	87	48	,,		
310	4¾	7	3	3½	85	48	,,		♂?.
380	5¼	7	3	4	90	50	,,		

Young of ? *Labeo seeberi.*

Fig. 5.

Some very young specimens, 9·5–15 mm., were taken at Keerom, Upper Olifants River, on 16th April 1938 (K. H. B., A. C. H., C. W. T.).

They are more heavily pigmented than the young of any of the species of *Barbus* occurring in the Olifants River, and would be, with considerable confidence, referred to *Labeo*, but for the fact that in the largest specimen (15 mm.) (only one of this size) the ventrals arise below the anterior spines of the dorsal fin, a position that is not in keeping with the adults of any species of *Labeo*. In the dorsal fin 7, possibly 8, rays can be counted, and 5 in the anal.

In addition to the pigmentation, the fact that at 15 mm. there still remains an appreciable amount of the ventral lamina, shows that these young do not belong to the Olifants River species of *Barbus*, all of which have been traced back stage by stage.

In the *Barbus* species the ventral lamina disappears at about the 13-mm. stage, except in *B. cernuus* where it can still be traced in

the 15-mm. stage, though it has completely disappeared at 16 mm. But in *B. cernuus* the ventral fins are well formed and free at the 13-mm. stage, whereas in the 15-mm. ? *Labeo* specimen they are merely tiny lobes.

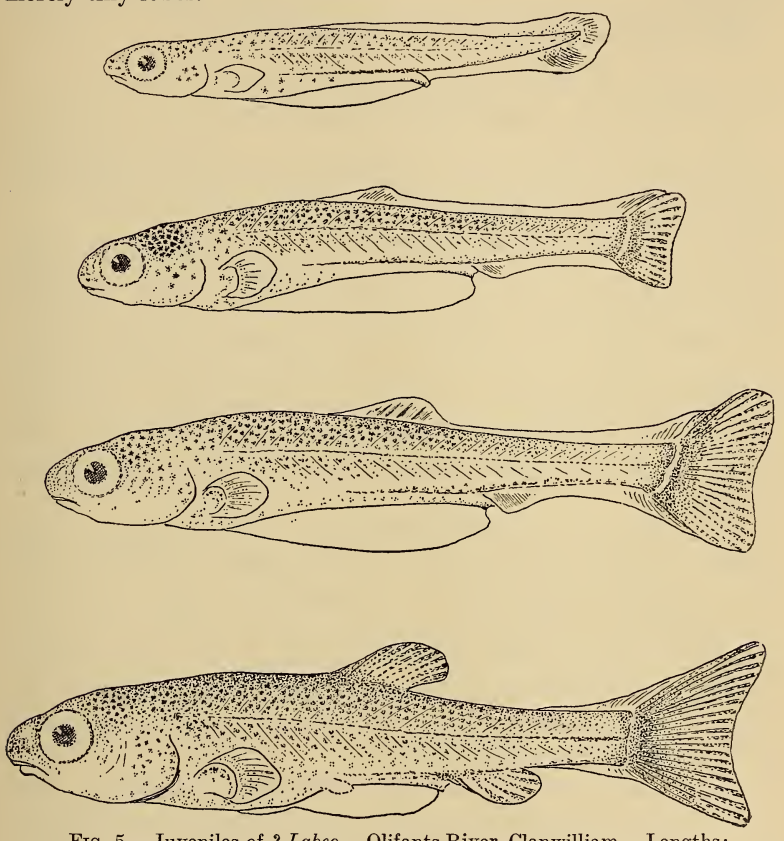


Fig. 5.—Juveniles of ? *Labeo*. Olifants River, Clanwilliam. Lengths: 9·5 mm., 10·5 mm., 12 mm., and 15 mm.

	$\frac{L}{H}$	$\frac{H}{E}$	$\frac{S}{E}$	$\frac{I}{E}$	Scales.	Barbs.	
9·5	$4\frac{3}{4}$	$2\frac{1}{2}$	$e > s$	$e > i$	none	none	
10·5	$4\frac{1}{2}$	3	,,	,,	,,	,,	
12	$4\frac{1}{4}$	3	,,	,,	,,	,,	
15	$3\frac{3}{4}$	3	,,	,,	,,	,,	Dorsal and anal distinct. Ventral just beginning. Ventral lamina present.

Gen. Barbus Cuv.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, pp. 366, 554, 562.

1938. Barnard, Ann. Mag. Nat. Hist. (xi), 2, p. 80.

Taxonomic Characters.

The study of long series of specimens has shown the necessity of revising some of the characters which hitherto have been relied upon for distinguishing the species.

The number of dorsal spines is given as 3 in some cases, 4 in others. It seems, however, that 4 is the usual number; the first one being very small and often hidden under the skin and the hindmost predorsal scale. In juveniles of, *e.g.*, *burchelli* and *vulneratus* the 4 spines are distinct, but in the adult the true 1st spine is not discernible without dissection. In *calidus* all 4 spines are at all stages more distinct than usual. In practice therefore the number given in the dorsal fin formula is that which is usually visible without dissection.

Similarly in the anal fin the 1st spine is often indistinct in the adult, so that observers have given 2 anal spines in their descriptions (see also under *pallidus*, and note on *viviparus*).

Although the normal number of dorsal and anal branched rays is generally distinctive for many of the species, too much reliance should not be placed on these formulae in identifying single specimens. The following instance will serve to show the possibilities of error in this respect (*cf.* also *pallidus*, p. 194).

On 13th and 14th February 1939 at Keerom on the Olifants River above Citrusdal (Clanwilliam Division), a large quantity of young fry was collected, viz. 723 specimens of 25 mm., and under, in length, comprising the following (only the branched rays are counted):—

capensis,	normal, D 9, A 5.	Number of specimens, . .	44
	D 8, A 5.	,,	2
	D 10, A 5.	,,	1
serra,	normal, D 8, A 5.	,,	122
	D 8, A 6.	,,	9
	D 8, A 7.	,,	2
	D 7, A 5.	,,	1
	D 8, A 3 (spines and 2 rays absent) . .		1

calidus,	normal, D 7, A 6.	Number of specimens . .	470
	D 8, A 6.	„	1
	D 7, A 7.	„	19
phlegethon,	normal, D 7, A 5.	„	50
	D 7, A 6.	„	1

In all cases the abnormality is caused by the interpolation or omission of one or two rays, the last ray being as usual a double one (counted as one).

There are of course collateral characters by which the true identity of a specimen can be determined; the dorsal and anal fin formula being only a "first aid." For example, the shape of the anal fin will show whether a specimen with D 7 and A 6 (rays) is a normal *calidus* or an abnormal *phlegethon*; or again, the details of the colour pattern and the position of the ventral fins will distinguish an "8/5" *capensis* from a *serra*.

Ignorance, or possibly a glossing-over, of sexual characters has been responsible for the institution of "new species." In several of the smaller species the relative length of the pectoral fin varies: in males it reaches to, or nearly to, the base of the ventral fin spine; whereas in adult females it is shorter, leaving a definite gap between the end of the pectoral and base of ventral amounting to about $\frac{1}{3}$ or $\frac{2}{5}$ the length of pectoral fin. In most of the species showing this sexual difference the juveniles are more like the male, but in *anoplus*, *cernuus*, and *phlegethon* the juveniles are like the female. That is, in the former the pectoral fin becomes relatively shortened in the female, in the latter relatively lengthened in the male.

In the larger species, on the other hand, the pectoral fin does not seem to show any sexual difference in length.

Max Weber (1897) appears to have regarded the length of the pectoral fin as a specific character. The only real distinction between *burgi* Blgr. and *burchelli* is the length of the pectoral fin, and yet Boulenger in describing *asper* later on in the same work definitely notes the difference in length as being sexual.

The anal fin shows no sexual differences,* but in most descriptions the extent of the fin (reaching, or not reaching, to base of caudal fin) is mentioned, and several different shapes are represented in the illustrations (see Boulenger, and Gilchrist and Thompson, *l.c.*). So far as I am aware no comment has been made on these differences

* Such as occur in some Indian species (Hora and Misra., J. Bombay N.H. Soc., xl, 1938); and in *B. wöhlerti* (Trewavas, Ann. Mag. Nat. Hist. (xi), ii, p. 64, 1938).

in the various species, or on the possibility of their being due to growth-changes. Among the species dealt with here, a growth-change occurs in *holubi* and *capensis* (*q.v.*), and there is an essential difference in shape between the anal fin of these two species and all the other S.W. Cape species.

The difference in shape is seen by comparison of the figures of *holubi*, or *capensis*, and *serra* (*cf.* figs. 8 and 9 with 12, etc.). In the former the 1st branched ray when folded back extends, at all stages, beyond the end of the last ray; in the latter the last ray extends beyond the 1st ray. In *andrewi*, *burchelli*, etc., the 1st and last rays extend about equally far back, the former slightly less far in adult than in young—that is, the fin (as also the dorsal and ventral fins) becomes somewhat shortened or bluntened in adult (see fig. 16).

It so happens that both the species in which this growth-change occurs are species with longitudinally striate scales; but whether this correlation holds good for all the African or South African species needs investigation. From the illustrations in Boulenger's monograph it would seem that *rhoadesii* comes nearest to being an exception to the statement that all longitudinally striate species have an elongate anal fin in the adult. On the other hand, amongst the radiately striate species there seem to be several with an elongate anal fin, taking Africa as a whole, but none among the S.W. Cape species.

The males of several species, particularly the smaller species, develop large conical tubercles on the snout and top of the head. It is not yet known whether these tubercles are developed only at certain seasons when breeding takes place, or, once developed, are retained throughout life. In preserved specimens they are often easily caducous, but this may be merely the effect of the preservative. *B. asper* and *burchelli* are good examples. In the Modderfontein specimen recorded (erroneously) as *anoplus* by Gilchrist and Thompson (*l.c.*, p. 429) the tubercles are very numerous, extending over inter-orbital, snout, preopercle, sub- and pre-orbital, upper lip, chin, and rami of lower jaw. In the Indian species *B. hexagonolepis* they occur in a patch on the sub- and pre-orbital (Hora, 1940, J. Bombay Nat. Hist. Soc., xlii, pp. 81, 82, figs. 1, 2, and pl.).

The larger species do not develop these relatively large and few tubercles. Instead, both sexes may have the top of the head and snout thickly sprinkled with numerous minute pimples (cf. *Labeo*, p. 130). *B. holubi* (and *kimberleyensis*), and *andrewi*, *e.g.*, have these pimples, but *capensis* and *serra* apparently have not. They are

very noticeable in *hospes* (♂, adult ♀ unknown), and often so in *calidus*; but as remarked under *Labeo* their conspicuousness seems to be dependent to some extent on the method or state of preservation.

In two Indian species (*B. kolus* and *ticto*) Hora and Misra (1938, J. Bombay N.H. Soc., xl, pp. 28, 29, pl. 1 and fig. 3) find that tubercles are developed in the males not only on the sides of the snout, but also on certain rays of the anal fin and lower lobe of the caudal. Trewavas (1938, Ann. Mag. Nat. Hist. (xi), ii, pl. 64) finds the same in *B. wöhlerti*, a species believed to have been found in Mozambique. This has not been observed in any of the S.W. Cape species.

External Sexual Differences.

	Difference in Length of Pectoral Fin.	Pimples or Tubercles on Head.
holubi . .	None.	Minute pimples in both sexes.
capensis .	None.	None.
serra . .	None.	None.
andrewi . .	None.	Minute pimples in both sexes.
calidus . .	None.	,,
paludinosus .	None.	None.
hospes . .	Not reaching ventral ♂, ? ♀.	Minute pimples ♂, ? ♀.
burchelli .	Shorter in ♀ than in ♂.	Large tubercles in ♂.
vulneratus .	,,	,,
asper . .	,,	,,
senticeps .	,,	,,
tenuis . .	,,	None.
pallidus . .	,,	None.
anoplus . .	,,	None.
cernuus . .	,,	None.
phlegethon .	,,	None.
afer . .	Not reaching ventral ♀, ? ♂.	?.

The institution of new species solely or mainly on the presence of enlarged fleshy lips and labial lobes appears quite unwarranted (*cf.* Worthington, Proc. Zool. Soc. Lond., 1929, p. 131). These "rubber-lip" forms (see under *capensis*, p. 166) seem to occur only in those species with longitudinally striate scales.*

* *B. labialis*, G. and T., 1913, appears to be an exception; but the specimen is not in the South African Museum, and I have not had an opportunity of checking whether the scales really are radiately striated.

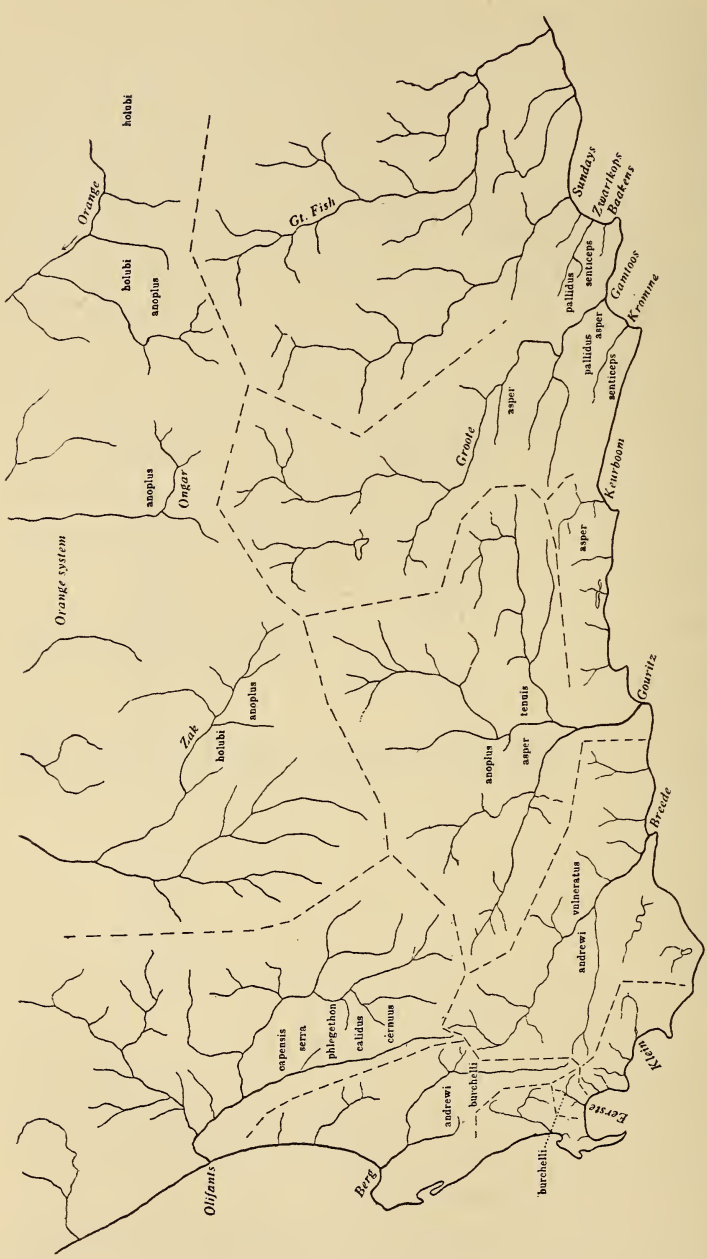


FIG. 6.—Distribution of the species of *Barbus* in southern Cape region. The three forms: *anoplus* f. *typica* (Gouritz system), f. *oraniensis* (Zak and Ongar rivers), and f. *cernuus* (Clanwilliam Olifants River) are extremely closely allied, especially the first and third forms.

The number of barbels, one or two pairs, has been regarded as a specific character, but it seems to have been assumed that the character is constant from juvenile to adult. This assumption is quite wrong, and no species can be said to be adequately described until the life-history has been studied and it is known at what stage the respective pairs of barbels (and scaling) are developed. The requisite series showing these stages have been obtained for nearly all the Cape species (table, p. 154).

As the anterior pair of barbels develops later, sometimes considerably later than the posterior pair, and sometimes not at all, it may happen that an immature specimen with only one pair of barbels is quite erroneously identified. This has actually happened (see *burchelli*).

From the tables given for each species it will be seen that other characters may change as the fish grows. An increase in the number of scales along the lateral line or around the caudal peduncle may take place concomitant with growth. Accessory scales are not infrequently developed, especially in fully grown specimens, around the caudal peduncle, and chiefly in the dorsal region. A long series of specimens, however, indicates clearly what is the normal number of scales. The increase is usually more marked in the larger than in the smaller species; but often the scale formula remains fairly constant for each species.

The bright red patches at the bases of the pectoral, ventral, dorsal, and anal fins, found in certain of the smaller species, known as "Redfins," are neither sexual nor seasonal. It may be, however, that the colour becomes more vivid during the actual breeding season. It is more vivid in males, and may become dull in spent females. Indications of the colour can be seen at quite an early stage, round about 30 mm. usually. None of the larger species develop these red patches, but in the case of some species the fins may be *wholly* suffused with a *pale* salmon or pink tinge.

Dark lateral bands, which are so often seen and described in preserved specimens, are usually not at all conspicuous in the living fishes.

The collecting and examination of long series of all stages is considered of paramount importance in diagnosing and fixing the limits of a species. For example, the difficulty of separating certain individual specimens which might have been either *burchelli* or *vulneratus* suggested that the two might be synonymous. But though the difficulty of separating isolated and individual specimens remains,

the long series of normal individuals at once showed that two species should be recognized. Another case is that of *anoplus* and *cernuus* (but see *infra*, p. 213). These cases are important also from the geographic point of view, because once the morphological difference was demonstrated, each species was found to be confined to its own particular river-system.

From the foregoing it will be seen how cautious one should be in accepting records based on single specimens, unless the species is a very clearly defined one.

B. gobionides C. and V. (Hist. Nat. Poiss., xvi, 1842, p. 189) is best relegated to oblivion, unless the type happens to be extant. The description is based on a single dried specimen, 4 inches long, collected by Verreaux, and there are said to be 26–30 scales [in one specimen!] along the side. The authors end their brief description by saying that the specimen may not be a *Barbus* in spite of its four barbels.

Distribution (figs. 6 and 7).—Subject to the aforesaid qualification (*supra*, p. 120), Hey's reports (*l.c.*) provide a useful survey of the distribution of certain species of this genus. Thus we find a "rooi-vlerkie" [Red-fin], although said to be exterminated in the Eerste River (Rep., i, p. 36), in the coastal belt from the Duivenhoks River (Heidelberg) to the Kromme River (Humansdorp). Farther east, from Cradock–Victoria East–Keiskama to Queenstown–Cathcart–Komgha, its place is taken by the "Gillieminkie," a "similar" fish but without red fins (Rep., i, p. 65). Hey also notes that the "Scaley," one of the larger species (*B. elephantis*), does not occur south of Natal.

So far as recent investigations in the S.W. Cape go, Hey's statements can be confirmed, except that the Red-fin is not extinct in the Eerste River; and the following points in the distribution of *Barbus* seem to be correct:—

1. None in the Cape Peninsula, and none on the Cape Flats, except in the Eerste River on the eastern border of the latter region.
2. Absent from the *smaller* rivers on the once-submerged post-Tertiary terrace. The Cape Flats being part of this terrace explains the absence of *Barbus* from the Cape Peninsula.
3. (*a*) Red-fin species (i.e. *calidus*, *phlegethon*, *burchelli*, *vulneratus*, *asper*, *tenuis*, *senticeps*) occur only in the Olifants (Clanwilliam), Berg, Eerste, Breede (and its former tributaries Nieuwjaar River and Grashoek River), Gouritz, Gamtoos, and Zwartkops systems, and intermediate localities. Their presence east of the Port Elizabeth area has not yet been confirmed.

(*b*) The occurrence of the true *anoplus* (not a Red-fin) in the Grahamstown, Alicedale, Pirie, and Bedford districts needs confirmation.

4. (*a*) No *large*-sized species (like *holubi*, *serra*, *capensis*, *andrewi*, *elephantis*, all over 150 mm.) are found in the area, *south of the main Cape watershed*, between the Breede River (*andrewi*) and Natal (*elephantis*).* The presence of *andrewi* in the Breede River seems a curious anomaly (see p. 113).

(*b*) No large-sized *radiately* striate scaled species except in the extreme west and south-west (Olifants, Berg, Breede rivers), in fact nowhere in the Cape, O.F.S., or Natal, south of the Limpopo system.

5. Only one species, viz. *andrewi* (see p. 114), is common to two totally distinct river-systems, the Berg and the Breede. But there is a very close relationship between *burchelli* (Berg River) and *vulneratus* (Breede River). An even closer relationship exists between *anoplus* (Gouritz system), *anoplus* var. (Zak and Ongers rivers, tributaries of the Orange River), and *cernuus* (Olifants River, Clanwilliam) (see p. 214).

Identification of Specimens.—During the progress of this investigation an attempt was made to construct keys applicable to every successive stage of growth at every 5 or 10 mm. But since it was found that each river-system has its own set of species, such keys would be redundant, apart from certain inherent difficulties.

From the table of development of barbels and scales (p. 154), it will be seen that all the species have attained their adult characters at a length of about 55 mm. A synopsis and key, applicable to specimens over that length, are given. For the identification of

* It is possible that this statement will have to be slightly modified, but until proper investigations have been made and actual specimens properly identified, the following two quotations are not to be regarded as contradicting it.

Hey (Survey Rep., no. 1, 1926, p. 66): "It is said that a few years back, mud-fish (a very bony fish) were taken from the Kat River . . . and placed in a dam in the Tyumie catchment area . . . and found their way into Tyumie River . . . after spreading over lower reaches of Tyumie it found its way into the Keiskama and has now become well established . . . to the detriment of the mullet which is a far more edible and desirable fish."

Harrison (Fish. Mar. Surv., Investig. Rep., 7, 1936, p. 73) in reporting on Black Bass in a Kat River dam, Fort Beaufort: "It [reservoir fed from Kat River] contains small fish, . . . and large 'yellow-fish' (a species of indigenous *Barbus*)."

If this really is a large-sized *Barbus*, it considerably reduces the area in which such fish are said to be absent. Personally I think it is more likely to be a *Labeo*.

Fig. 7.—Distribution of certain species of *Barbus* in the area between the eastern tributaries of the Gouritz River and the Sundays River.

□ *asper*. ◪ *asper* var.
○ *senticeps*. △ *pallidus*.

(Records based on recent material, except those from the Baakens River.)

specimens under that length, the table just mentioned should be a guide, in conjunction with other data.

As the characteristic number of dorsal and anal rays (branched) is developed at a very early stage, this character is of primary importance. The first five species in the synopsis (*infra*) are at once definitely signalized, and the only remaining difficulty is to separate those species combining 7 dorsal with 5 anal rays.*

It is important to notice that certain species in the latter "7/5"

Synopsis of the S.W. Cape species of Barbus, over 55 mm. (2 in.) in length.

	A.	R.	S.	Dorsal Rays.	Anal Rays.	Lateral Line Scales.	Caudal Peduncle Scales.	Pre-Dorsal Scales.†	Striae on Scales.	Barbels (pairs).
capensis	A	..	..	9	5	41–45	16–18 (20)	15–17	longi-tudinal	2
holubi	A	..	..	8–9	5	34–43	14–16	13–15	,,	2
andrewi	..	..	S	8	6	38–41	16	13–14	radiate	2
serra	..	..	S	8	5	41–44	20 (22)	18–20	,,	2
calidus	..	R	S	7	6	36–38	14–16	15	,.	2
paludinosus	..	..	S	7	5	33–36	16 (–18)	15–17	,,	2
hospes	..	..	S	7	5	37–39	16	21	,,	2
asper	..	R	..	7	5	35–41	16–18 (20)	19–25	,,	1
tenuis	..	R	..	7	5	33–36	12–14	17–20 (bare patch)	,,	1
senticeps	..	R	..	7	5	30–32	12	14–16	,,	1
vulneratus	..	R	..	7	5	33–26	14	17–18	,,	2
burchelli	..	R	..	7	5	30–36	12	13–15	,,	2
phlegethon	..	R	..	7	5	34–36	12	14–16	,,	1
pallidus	..	..	..	7	5	27–29	12	10–11	,,	2
afer	..	..	..	7	5	27	12	12	,,	1
anoplus	..	..	..	7	5	34–36	(14) 16	13	,,	1
cernuus	..	..	..	7	5	33–35	(14) 16	14–15	,,	1‡

A=anal fin with 1st branched ray extending beyond the last ray when folded back, the fin reaching in adult to or almost to base of caudal.

R=red-fin.

S=last dorsal spine serrate.

* David and Poll (Ann. Mus. Congo Belge., Zool., ser. 1, T. iii, fasc. 5, p. 262, 1937) in describing *B. microbarbus*, remark on the fact that the only species hitherto known with 6 anal rays were Moroccan species (Boulenger, *l.c.*, species 67–73). They overlooked Boulenger's "*capensis*" (=*andrewi*). We now know a second Cape species with 6 anal rays: *calidus*.

† On the variability of the predorsal scales, *cf.* Hora, Misra and Malik, 1939, Rec. Ind. Mus., xli, p. 269.

‡ Sometimes a second barbel developed on one side or both sides.

group never develop the anterior pair of barbels (with the one exception of *cernuus*, which occasionally does do so); and that in *burchelli* its development is delayed until a very late stage of growth.

If the locality of a juvenile specimen, which is required to be identified, is known (and if it is not, then the specimen is better ignored!), the identification is easier.

For example, in dealing with Olifants River (Clanwilliam) specimens, *capensis*, *serra*, and *calidus* on the one hand are each identified by their respective fin formulas, and on the other hand *phlegethon* and *cernuus* are distinguished one from the other by the caudal peduncle scale-count, and the number of striae on the scales. The anal rays (and caudal peduncle scales) separate the two Berg River species *andrewi* and *burchelli*. Of the three Gouritz River species *asper*, *tenuis*, and *anoplus*, the first is distinguished from the other two by the striae on the scales, and the second from the first and third by the caudal peduncle scale-count.

Key to S.W. Cape Species (specimens over 55 mm. (2½ in.) in length).

Group I.

Scales longitudinally striate (figs. 8, 9).
Last dorsal spine moderately or strongly enlarged, but never serrated.
Anal fin with 1st branched ray when folded back extending beyond the last ray, the fin in fully grown examples reaching to or almost to base of caudal.
Prominent conical warts on head in ♂ not developed.
Red-fins (brilliant patches at bases of fins) not developed.
Two pairs of barbels.
"Rubber-lips" sometimes developed.
Large species.

A. Last dorsal spine strongly enlarged. Ventral spine below or in advance of 1st dorsal spine . . . . . *holubi.*
B. Last dorsal spine feebly or only moderately enlarged. Ventral spine below 4th dorsal spine . . . . . *capensis.*

Group II.

Scales radiately striate (figs. 12, 16).
Last dorsal spine thin or moderately or strongly enlarged, smooth or serrate.
Anal fin with 1st ray when folded back not extending beyond last ray; no change in shape of fin from young to adult (in S.W. Cape species).
Prominent conical warts on head in ♂ in several of the smaller species.
Red-fins in some of the smaller species.
One pair or two pairs of barbels.
"Rubber-lips" not developed (in S.W. Cape species).
Large and small species.

A. Dorsal spine more or less enlarged; serrate. Two pairs of barbels. No large warts on head in ♂.

1. Dorsal rays 8. No red-fins. Large species.
   a. Anal rays 5. Dorsal spine strongly serrate. . . . *serra*.
   b. Anal rays 6. Dorsal spine feebly serrate * . . . *andrewi*.
2. Dorsal rays 7. Small species.
   a. Anal rays 5. No red-fins.
      i. When dorsal fin extended, anterior margin at 60°, hind margin at 90°, to long axis of body . *paludinosus*.
      ii. Anterior and hind margins both at 60° to body axis . *hospes*.
   b. Anal rays 6. Red-fins . . . . . *calidus*.

B. Dorsal spine not enlarged; thin and flexible; not serrate.
1. Two pairs of barbels.
   a. Radial striae on scales few (less than 20, usually less than 10).
      i. L.l. 30–35, c.ped. 12, pred. 13–15. Red-fins. Warts on head in ♂ . . . . . *burchelli*.
      ii. L.l. 33–36, c.ped. 14, pred. 17–18. Red-fins. Warts in ♂ . . . . . *vulneratus*.
      iii. L.l. 27–29, c.ped. 12, pred. 10–11. No red-fins. No warts . . . . . *pallidus*.
   b. Radial striae numerous (20–30). L.l. 33–35, c.ped. 16, pred. 14–15. No red-fins. No warts in ♂ . *anoplus* f. *cernuus* †
2. One (the posterior) pair of barbels.
   a. Radial striae few (less than 20). Red-fins.
      i. C.ped. 16–18(20), pred. 19–25. Warts on head in ♂ . *asper*.
      ii. C.ped. 12, pred. 14. Warts in ♂ . . . *senticeps*.
      iii. C.ped. 12, pred. 14–16. No warts. . . . *phlegethon*.
   b. Radial striae numerous (20–30, or more).
      i. C.ped. 12(14), pred. 17–20. Red-fins. No warts in ♂ . *tenuis*.
      ii. C.ped. 16, pred. 13–15. No red-fins. No warts . *anoplus*.

Barbus holubi Stndr.

Holub's Yellow-fish, Geelvis.

Fig. 8.

1894. Steindachner, Sb. Ak. Wiss. Wien, ciii, p. 449, pl. 3, fig. 1.

1897. Weber, Zool. Jahrb. Abt. Syst., x, p. 151 (*capensis* non A. Smith, non Boulenger; part: juv. from Viol's Drift, Orange River).

1911. Boulenger, Cat. Fw. Fish. Afr., ii, p. 22, fig. 4.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 374, fig. 35.

1937. J. L. B. Smith, Guide Vert. East. Prov., Albany Mus., Grahamstown, ii, p. 126, pl. 31, fig. 1.

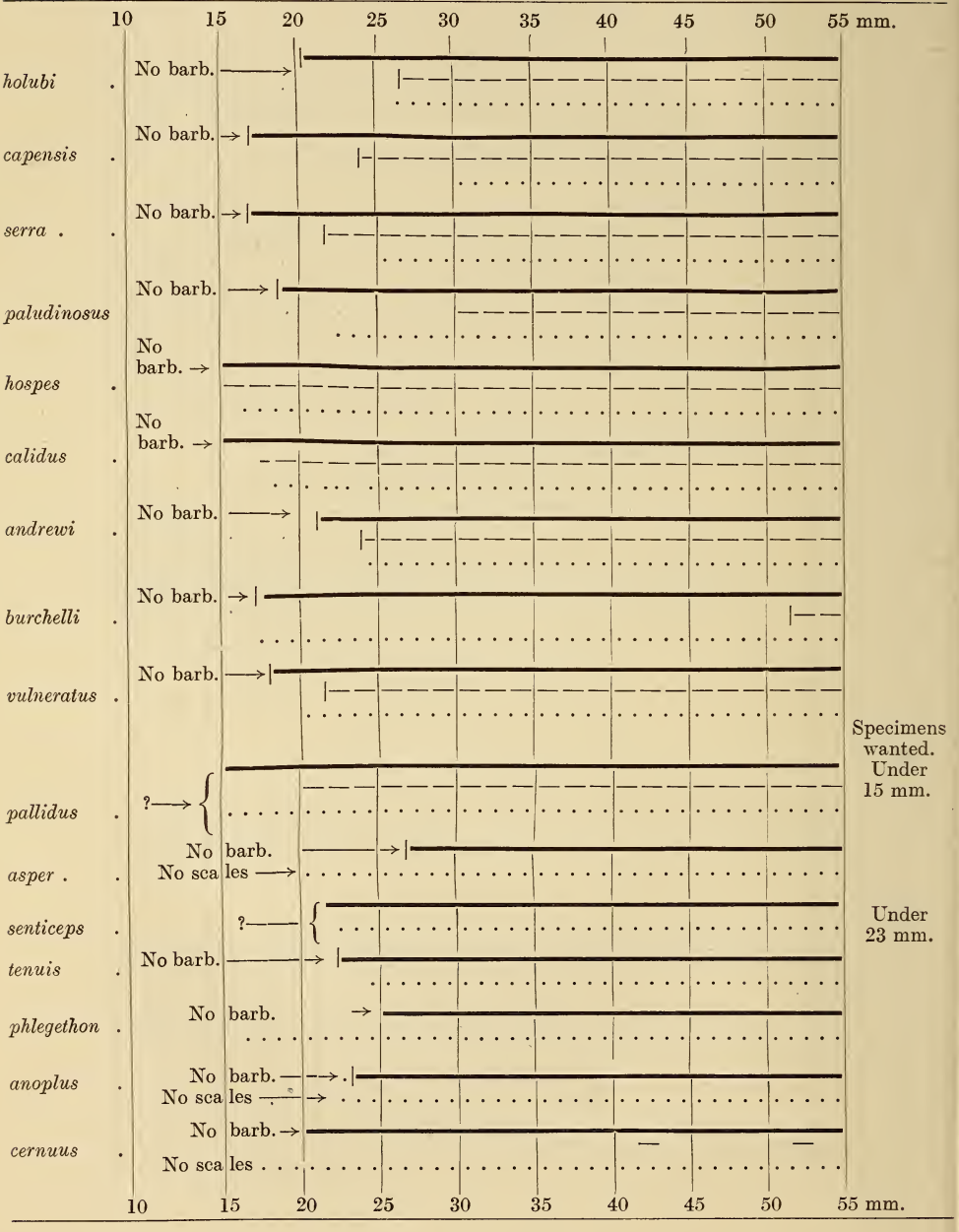
1938. Barnard, Ann. Mag. Nat. Hist. (xi), 2, p. 81.

* Serrations sometimes obsolete in large specimens.

† Normally only one pair of barbels, but occasionally the anterior barbel is developed on one or both sides.

Barbus, development of barbels and scales. Early stages complete for each species except *pallidus* and *senticeps*.

——— posterior barbel. — — — anterior barbel. . . . . scales.



This species is easily distinguished by the very stout and non-serrated 4th dorsal spine, the longitudinally striated scales, and the ventral fins arising below or slightly in advance of the 1st dorsal spine.

In half-grown, and more so in fully grown, specimens the nape rises very sharply immediately behind the head, and more so in ovigerous ♀♀ than in ♂♂; in one very large specimen (410 mm.) the head appears ridiculously small in comparison with the depth of the fish.

The species appears to be distributed throughout the whole of the Orange River system. The localities nearest to our area, so far known, are the Zak River (Fraserburg) (fig. 6), above the Aughrabies Falls (Orange River), and Goodhouse on the lower reaches of the Orange River. Having a long series from the latter locality, and also from the Great Fish River in South West Africa, some remarks on growth-changes may not be out of place here.

The tables are compiled from 103 specimens from Goodhouse, 12–82 mm. in length, and 109 specimens from Aiais on the Great Fish River, 30–215 mm. in length (Nov. 1936). A few specimens from other localities are also given.

The posterior barbel begins to develop at about 20–21 mm., the anterior one at about 26–27 mm.; at the latter size the scales also are just becoming recognizable. There are at first 14 scales around the caudal peduncle, but very soon the full normal number of 16 is developed.

The striae on the scales increase from 4–5 when the scales are first formed, up to about 36 (410 mm.).

Although the number of dorsal fin rays is given as 8, 9 would appear to be an equally typical number. In some communities the number 9 predominates, in others 8, and in others again both numbers might occur in equal proportions, judging by the specimens at hand.

Gilchrist and Thompson did not mention any specimens with 9 dorsal rays, but amongst their material there are the following:—

One specimen	out of	3,	from	Kraai River, Aliwal North.
One	,,	,, 3,	,,	Modder River, Kimberley.
Two specimens	,,	3,	,,	Mooi River, Potchefstroom.
One specimen	,,	7,	,,	Potchefstroom (see *infra*, under *kimberleyensis*).

I have also seen 2 specimens out of 3 collected in the Great Fish River at Gibeon (South West Africa), with 9 dorsal rays. From the

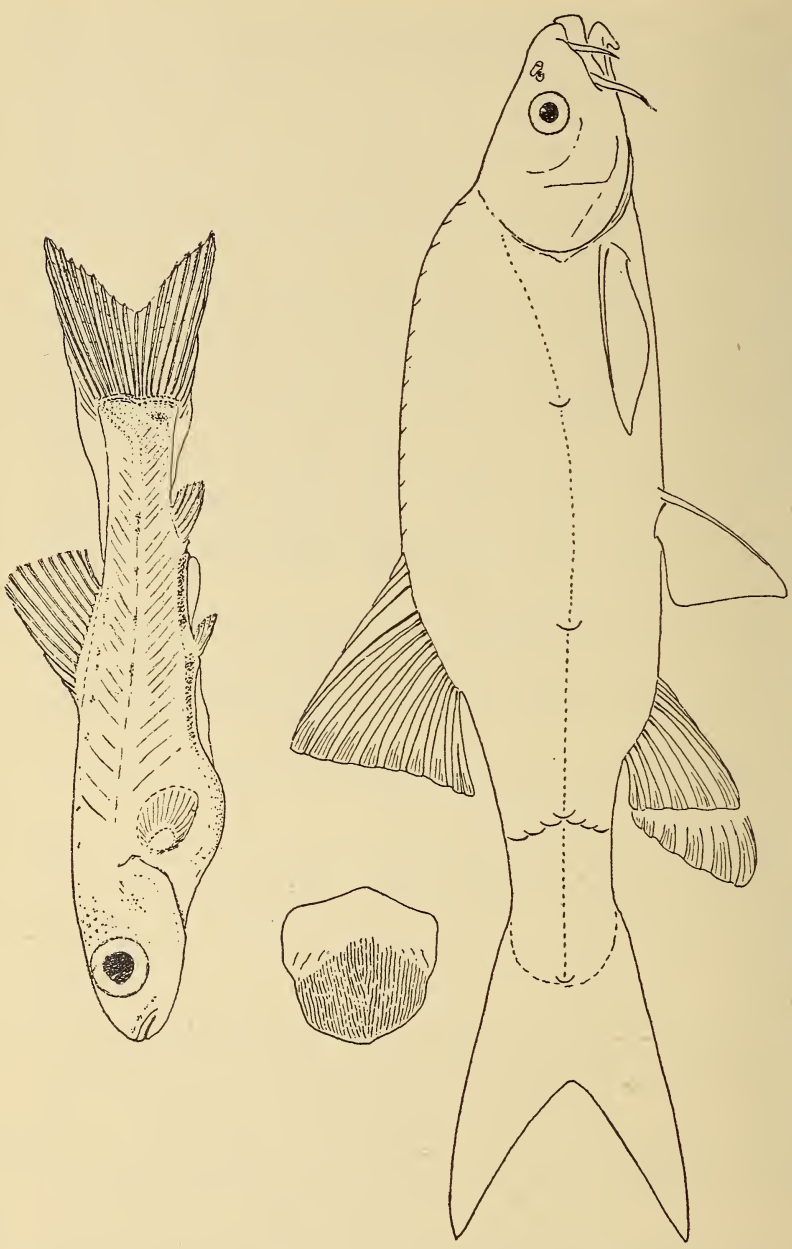


FIG. 8.—*Barbus holubi*. Juvenile, 12 mm. Goodhouse, Orange River. Adult, with scale enlarged; predorsal scales and every 10th scale in lateral line indicated; anal fin showing change in shape from young and half-grown to adult.

latter river at Aiais (*i.e.* nearer its confluence with the Orange River), out of 109 specimens of various sizes there are 24 with 8 rays, one with only 7, while the rest have 9. Of the 103 specimens from Goodhouse on the Orange River only 6 have 8 rays. Out of 27 specimens from the Orange River above the Aughrabies Falls 9 have 9 rays, 17 have 8 rays, and one has only 7 rays. Max Weber's specimens from Viol's Drift on the Orange River also had 9 rays.*

The proportions of the fish vary. Up to about 80–90 mm. the length of the head is greater than the depth of the body; from this size up to about 190–200 mm. these two measurements are sub-equal; from about the latter size upwards the head-length is less than the body-depth owing to the development of the nape.

In very young stages up to about 40 mm., the base of the ventral fin spine is situated below the 4th dorsal spine; it then shifts forward (relatively) to below the 1st dorsal spine, and from about 90–100 mm. onwards it is slightly in advance of the vertical from the 1st dorsal spine.

Growth-change occurs in the anal fin, similar to that described in *capensis* (*q.v.*).

The ends of the lower labial grooves are connected by a groove or fold across the chin from quite an early stage (30 mm.) upwards; but the chin-lobe does not develop (in the specimens at hand) very strongly, being always broader than long, with a very short freely projecting flap. In one 300-mm. ♀ (Kimberley), however, there is a well-developed freely projecting flap as long as it is broad, evidently an incipient "rubber-lip" (see *infra*, *capensis*, p. 166).

The 410-mm. ♀ from Zak River (length as given by G. and T. 360 mm.) is the largest specimen I have seen.

Colour (Aiais specimens, freshly preserved); half-grown and smaller specimens with irregular dark spots on upper part of body, these spots usually somewhat vertically oval in shape, or even like short vertical cross-bars, usually a sub-triangular spot on the lat. line at end of caudal peduncle.

Burchell (1822) says of Zak River specimens: "A beautiful kind of carp entirely of a yellow-green with a brazen lustre."

Boulenger (*l.c.*, 1911, pp. 23 and 144 resp.) refers to the two inadequately described species of Castelnau, *natalensis* and *kurumanni* [original spelling], under *holubi* and *trevelyani* respectively. It seems to me far more likely that *natalensis* is the same as *elephantis* Blgr.;

* I have to thank Professor de Beaufort as well as the late Professor Max Weber for their courtesy in sending these specimens for my personal inspection.

while from the locality, the dorsal spine being "très forte," and the black spot at base of tail, *kurumanni* is obviously *trimaculatus*.* Castelnau's *natalensis*, however, should be ignored unless the type specimen can be found.

Boulenger (*l.c.*, 1916, p. 223) places *lineolatus* G. and T. and *zuluensis* G. and T. as synonyms of *holubi*. The former certainly has 4 (not 3) dorsal spines, but the latter has only 3. In neither species does the ventral fin arise in advance of the dorsal fin, as it does in typical *holubi* of the sizes given for these species. And in *zuluensis* the lower labial grooves are discontinuous across the chin. Thus, whatever *lineolatus* may be, *zuluensis* cannot be regarded as synonymous with *holubi*. The localities also are not altogether in keeping with the distribution of *holubi*.

Barbus holubi.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Goodhouse, Orange R.	12–13	$3\frac{1}{3}$	3	e > s	e > i	No s	cales		7 weak	None	Dorsal and anal rays distinct.
	14	3	3	,,	,,	,,	,,		,,	,,	
	15–16	3	3	,,	,,	,,	,,		7–8	,,	
	17–18	3	3	,,	,,	,,	,,		0+9	,,	
	20–21	3	3	,,	,,	,,	,,		0–1+9	(p)	
	22–23	3	3	,,	,,	,,	,,		1+9	p	
	25–26	3	3	,,	,,	,,	,,			p	
	27	3	3	,,	,,	Scarce	ly disti	nct	1+9	p (a)	
	28	3	3	,,	,,	37	14		1+9	p (a)	
Aiais, Gr. Fish R., S.W.A.	30	3	3	,,	,,	37–38	14–16	4–5	1+9	p a	
	33	$3\frac{1}{6}$	3	,,	1			,,	1+9	p a	
	35	$3\frac{1}{5}$	$3\frac{1}{3}$	,,	1			6–7	2+9		
	40	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1						
	45	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1				2+10		
	50	$3\frac{1}{4}$–$3\frac{1}{3}$	$3\frac{1}{2}$	1	1			10			
	55	$3\frac{1}{3}$–$3\frac{1}{2}$	$3\frac{2}{3}$	1	$1\frac{1}{5}$						
	60	$3\frac{1}{2}$	$3\frac{3}{4}$	1	$1\frac{1}{5}$				3+10		
	65	$3\frac{1}{2}$	$3\frac{4}{5}$	$1\frac{1}{5}$	$1\frac{1}{5}$			12			
	70	$3\frac{1}{2}$	$3\frac{4}{5}$	$1\frac{1}{5}$	$1\frac{1}{5}$				3+11		
	75	$3\frac{1}{2}$	$3\frac{4}{5}$–4	$1\frac{1}{5}$–$1\frac{1}{4}$	$1\frac{1}{5}$–$1\frac{1}{4}$						
	80	$3\frac{1}{2}$	4	$1\frac{1}{4}$	$1\frac{1}{3}$	38–41	16		4+11		
	85	$3\frac{1}{2}$	$4\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{3}$						
	90	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$						
	100	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$			14–15			
	105	$3\frac{2}{3}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$				4+11		
	160	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$			18			
	170	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$						Minute white pimples on head.
	180	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$–$1\frac{2}{3}$			20			
	190	4	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$–$1\frac{2}{3}$						
	195	4	$4\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{2}{3}$						Minute white pimples.
	215	$4\frac{1}{2}$	5	$1\frac{1}{2}$	$1\frac{2}{3}$			25	4+11		

* Specimens from Kuruman, recently collected, confirm this latter synonymy.

Barbus holubi.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Modder R. . 55	3½	3⅓	1	1	40	16	10	2+10	p a	
Upington, Orange R. 62	3½	3½	1	1 1/10	37	16	..	3+10	p a	
Upington, Orange R. 66	3½	3½	1	1⅕	40	16	12	3+10		
Upington, Orange R. 68	3½	3½	1	1⅕	40	16	..	4+11		
Gibeon, S.W.A. 68	3½	3½	1	1⅕	40	16				
Modder R., Kimberley 75	3⅖	4	1⅕	1¼	38	16	14	4+10		
Modder R., Kimberley 81	3½	4¼	1⅕	1¼	40	16	..	4+11		
Gibeon, S.W.A. 94	3½	4⅓	1⅕	1¼	40	16	..	4+11		
Upington 125	3½	4⅓	1¼	1½	42	16	15	4+11		
Upington 145	3¾	4½	1½	1⅔	41	16	17	4+12		
Vaal R. . . 170	3¾	4½	1½	1¾	41	16	20	4+11		
Kimberley . 300	4	6	2	2	40	16	34	4+11		♀.
Zak R. . . 410	4	8½	2½	3⅕	40	16	36	4+11		♀.

Barbus kimberleyensis

Potchefstroom D iv. 8. 115	3⅔	4⅕	1⅓	1⅓	..	..	16–17			
Potchefstroom D iv. 8. 125	3¾	4½	1½	1½	..	..	..	..	..	♂ pimples.
Potchefstroom D iv. 8. 160	3¾	5⅓	1⅔	1¾	..	..	..	..	..	♂.
Potchefstroom D iv. 8. 190	3⅘	5½	1¾	1¾	..	..	..	..	..	♂ pimples.
Potchefstroom D iv. 8. 222	4	5½	1¾	2	..	..	25	..	..	♂ few pimples.
Potchefstroom D iv. 8. 280	4	6	2	2⅕	..	..	..	..	..	♂ pimples.
Kimberley Reservoir D iv. 9. 375	3½	7½	2½	2⅕	..	..	48	..	..	♂ Type.
Largest and 3 others D iv. 9. 41	3⅓	3½	1	1						
Largest and 3 others D iv. 9. 50	3½	3½	1	1	..	..	10			
Largest and 3 others D iv. 9. 57	3½	3½	1	1						
7 with D iv. 9 72	3½	3½	1	1						
Warrenton 80	3½	4	1	1	..	..	12–14			
Warrenton 180	3¾	5	1⅓	1⅓	..	..	24	..	..	Immature. No pimples.

Barbus kimberleyensis G. and T.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 378, fig. 38.

1916. Boulenger, Cat. Fw. Fish. Afr., iv, p. 226, fig. 142.

1938. Barnard, *l.c.*, p. 82.

This species was based on a single specimen of very different appearance from typical *holubi*. The type came from the Kimberley Reservoir, which is fed from the Vaal River near Riverton.* Apart from its slender body, which lacks the prominent bulge on the nape

* My thanks are due to Miss Wilman, Curator of the McGregor Memorial Museum, Kimberley, for making enquiries of the Town Clerk, who stated (*in litt.* 22/ii/37) that the Reservoir was first filled in 1883, and that it now contained large numbers of indigenous fishes commonly called yellow-fish (a 12-pounder was caught in 1936), silver-fish, mud-fish, barbel, carp, and *Tilapia sparmanni*.

(depth at least 4½ in length excl. caudal fin), the presence of 9 dorsal rays evidently seemed to the authors to warrant specific separation.

But any attempt to separate *kimberleyensis* from *holubi* on other characters fails, and the above demonstration that *holubi* of typical body-shape can have either 8 or 9 dorsal rays, reduces the differences to one of body-shape only.

Among Gilchrist and Thompson's material are 7 specimens from Potchefstroom which these authors apparently identified as *holubi* without further ado. One of these (255 mm., but not the one so measured by G. and T.) has the typical *holubi* body-shape, but in spite of its size the head-length is not less than the body-depth; and it has 9 dorsal rays. The other 6 specimens, including the largest one of 280 mm., are typical *kimberleyensis* in body-shape, but have 8 dorsal rays. These 6, together with 11 from Warrenton, are included in the table with the type of *kimberleyensis*.

Although all these 6 specimens and the type are ♂♂, the difference in body-shape is apparently not sexual, as there are in the collection undoubted ♂♂ with the typical *holubi* shape. The 125, 190, 222, and 280 mm. specimens have the top of the head and snout more or less thickly sprinkled with minute pearly pimples.

The status of *kimberleyensis* is thus doubtful, and before making any decision it might prove interesting to investigate the *holubi–kimberleyensis* community in the Kimberley Reservoir. The problem is outside the scope of the present paper, and has only been mentioned because it arose inevitably out of the study of the *holubi* material.

Barbus marequensis A. Smith

1841. A. Smith, Illustr. Zool. S. Afr. Fish., pl. 10, fig. 2.

1911. Boulenger, *l.c.*, p. 36, fig. 16.

1913. Gilchrist and Thompson, *l.c.*, p. 377, fig. 37 (after Blgr.).

A stuffed specimen, regarded as "one of the types," 350 mm. in length, is in the British Museum. According to Boulenger it has 33 scales in the lateral line and 12 around the caudal peduncle, and the last dorsal spine is "rather feeble." Smith's figure shows about 45 scales in l.l. and 14 around caudal peduncle, and gives the impression that the last dorsal spine is rather *strong*, although perhaps not so strong as in typical *holubi*.*

* On variability in size and strength of the last (or main) dorsal spine in *B. hexagonolepis* McC., see Hora, 1940, J. Bombay Nat. Hist. Soc., xlii, p. 82, fig. 4. It is found that the fishes from rivers flowing through limestone areas have better developed dorsal spines.

The figure given by Boulenger is a black-and-white reproduction of Smith's coloured figure. The so-called type specimen should be re-examined.

Although other species of *Barbus* have been recorded from the tributaries of the Limpopo River, no one has yet recorded any specimens from the Marico River under the name *marequensis*. Gilchrist and Thompson recorded specimens of *holubi* from Six-mile Spruit (Hennops River), Dwaars River, and Pienaars River, all tributaries of the Limpopo. As these specimens are not in the South African Museum, I enquired whether the Transvaal Museum had any *Barbus* material from the Marico River, with a view to determining what species are present in this river, and, if *holubi* is present, whether it is actually the same as the Orange River *holubi*.

Thanks to the Director and Dr. Fitzsimons, I have been able to examine 5 specimens of "*holubi*" from near Zeerust on the Marico River, a locality about 70–80 miles distant from Andrew Smith's type locality.

As *marequensis* is obviously not closely allied to any other form but *holubi*, it would be reasonable to assume that the Zeerust specimens are representatives of *marequensis*. And the assumption would be strengthened if a re-examination of the type showed that Smith's figure, as regards the number of scales, is nearer the truth than Boulenger's statements.

A further question is whether the Marico specimens are to be regarded as specifically the same as the Orange River *holubi*. A table of the 5 Transvaal Museum specimens is given for comparison with typical *holubi*.

The differences which can be observed are not so significant as the trend of variation.

It has been stated above (p. 157) that in *holubi* from about 90 mm. upwards the length of the head becomes approximately equal to the depth of body, but here the head-length is definitely greater than the depth in specimens up to a length of nearly 200 mm.

Secondly (also *cf.* p. 157), whereas in *holubi* the base of the ventral spine gradually shifts forward so that in specimens from about 90–100 mm. upwards it lies slightly in advance of the 1st dorsal spine, here even in the largest specimens it has not yet reached a position in *advance* of the 1st dorsal spine.

Far more material is necessary, especially a complete series showing the growth-changes of the Marico River "*holubi*"; but it seems not unlikely that *holubi* and *marequensis* may be regarded as two extremely

closely allied species, the former inhabiting the Orange system and the latter the Limpopo system. The extent of the distribution within the Limpopo system should also be investigated.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	H : D.	Sex and Remarks.
(*a*) 150	3⅘	4¾	1½	1⅔	41	16	H > D	Immat. ?♂. V below 3rd–4th dorsal spines.
(*b*) 175	3⅔	5	1⅔	1⅔	40	16	H > D	Immat. V below 3rd dorsal spine.
(*c*) 190	3¾	5¼	1⅔	1¾	41	16	H > D	♂. V below 2nd–3rd dorsal spines.
(*d*) 200	3¾	5	1⅔	1¾	40	16	H ≡ D	♂. V below 3rd dorsal spine.
(*e*) 200	3⅔	5¼	1¾	1⅘	42	16	H ≡ D	♂. V below 1st dorsal spine.

In all specimens D iv. 8. In (*d*) the 1st dorsal spine seems to have been torn out, or to be degenerate. In (*b*) the right anterior barbel is bifurcated. V = ventral spine. H = length of head. D = depth of body.

Barbus capensis A. Smith

Clanwilliam Yellow-fish, Geelvis.

Figs. 9–11.

1841. A. Smith, Illustr. Zool. S. Afr., pl. 10, fig. 1.
1913. Gilchrist and Thompson, *l.c.*, p. 398, fig. 57 (*seeberi*).
1916. Boulenger, *l.c.*, iv, p. 241, fig. 150 (*seeberi*).
1937. Barnard, Ann. Mag. Nat. Hist. (10), xix, p. 305.
1938. *Id.*, *l.c.*, p. 82.

[not *capensis* Weber, Zool. Jahrb. Abt. Syst., x, p. 151, 1897.
not *capensis* Pappenheim in Schultze, Reise, iv, p. 276, 1910.
not *capensis* Boulenger, *l.c.*, ii, p. 123, 1911, except A. Smith's type specimen.
not *capensis* Gilchrist and Thompson, *l.c.*, p. 412, 1913.
not *capensis* J. L. B. Smith, *l.c.*, p. 125, 1937.]

A large species characteristic of the Clanwilliam Olifants River (fig. 6), where of late years it has become known as an excellent sporting fish. Very large examples are known as "Kalverkop" (calf's head). Examples with fleshy lips are known to anglers as "rubber-lips"! *

* Trout-flies, by "Kingfisher." London, 1938. The author on p. 172, speaking of the Olifants River "rubber-lip," says specimens were identified with specimens at the South African Museum as "Barbus m'fongosi." No specimens were

Gilchrist and Thompson's description of *seeberi* was based on three specimens ranging from "95–102 mm." in length. In fact, "102" is a misprint for 210, the lengths of the specimens being 95, 115, and 210 mm. Owing to Boulenger having included *capensis* among the species with radiately striate scales, Gilchrist and Thompson were bound to consider their specimens as representing an undescribed species.

All three specimens seem to have been originally preserved in formalin, the tissues on the throat, chin, and lips are plump, and especially in the largest one the symphysial region is considerably puffed out. The groove connecting the ends of the lower labial grooves across the chin is consequently very inconspicuous, and it is not surprising that Gilchrist and Thompson stated "lower lip interrupted on chin." This groove is, however, traceable on the two smaller specimens, and in all fresh specimens is distinct.

Boulenger (*l.c.*) places the species after *gilchristi*, and says it is distinguished from the latter "chiefly by the interrupted lower-lip." It would seem, however, to be far more closely allied to *B. holubi*, which is widely distributed in the Orange River system. This latter species is occasionally found with 9 rays in the dorsal fin, and the resemblance of the two species is then very striking, the differences being in the enlargement of the 4th dorsal spine (strong in *holubi*, weak in *capensis*), the relative positions of the dorsal and ventral fins, the dorsal profile, and the extra scales around the caudal peduncle. One might suggest on morphological grounds that *holubi* and *capensis* are derivatives of one ancestral species.

The original description (of *seeberi*) can be emended or supplemented by the following details.

Depth sometimes 4, but usually $4\frac{1}{4}$–$4\frac{1}{2}$ in length of body (excluding caudal fin). Depth of caudal peduncle twice or nearly twice in its length. D iv. 9. Base of 1st dorsal spine equidistant between tip of snout and base of middle caudal rays (or slightly nearer the latter). Anal fin in large specimens reaching to base of caudal fin, shorter in half-grown and young specimens (*v. infra*). Ventral spine arising in vertical from 4th dorsal spine. Scales l.l. 41–45; around caudal peduncle 16 in young, 16–18 in half-grown, and (usually) 18 in adult (16 in a 635 mm. ♂, and 20 in a 650 mm. ♀, see table); predorsal

submitted for official identification. The author saw the specimens formerly exhibited in glass cases in the Museum, among which was a Natal "rubber-lip" labelled *m'fongosi*. Needless to say, the "rubber-lip" is the only point of resemblance.

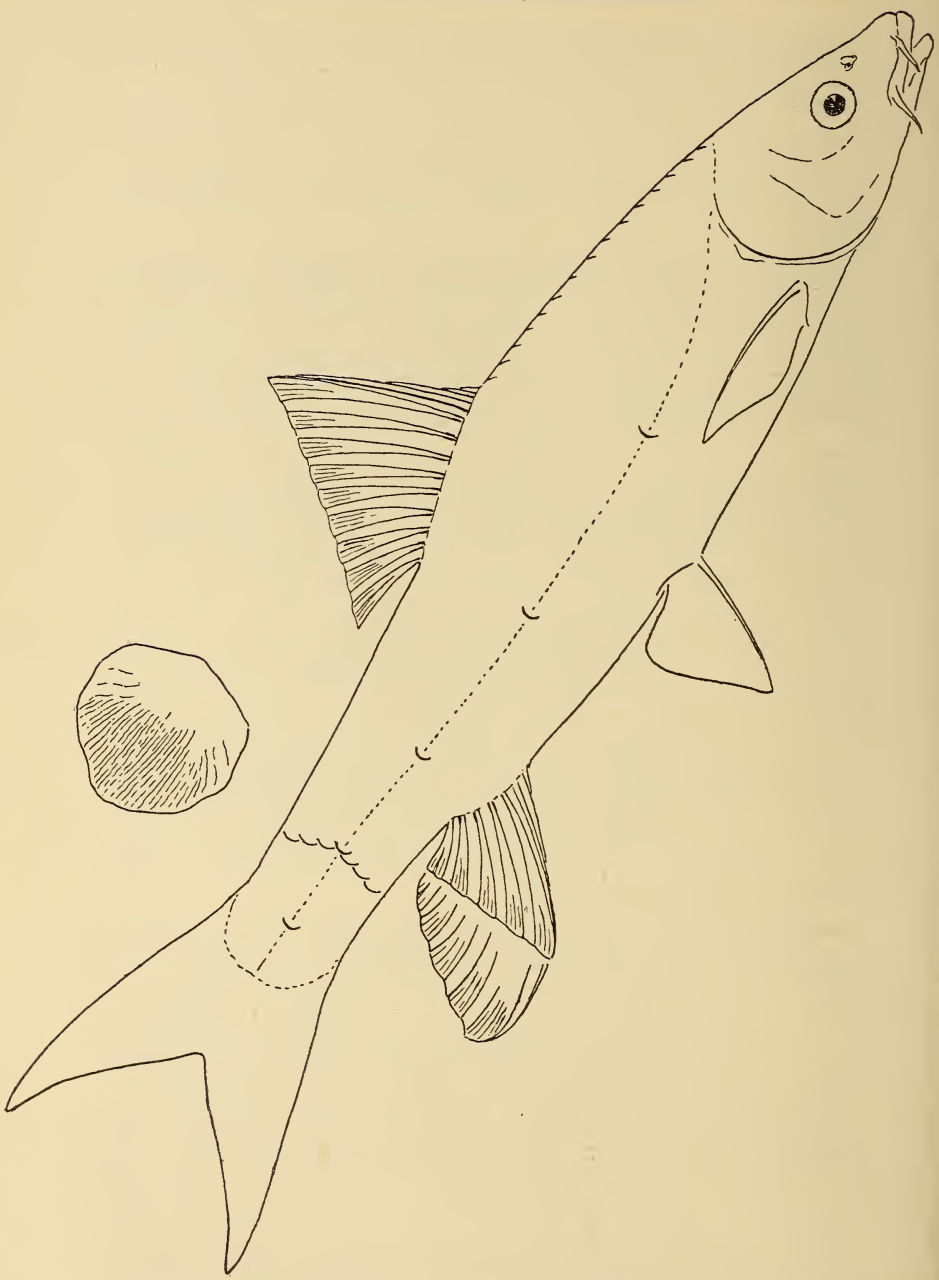


FIG. 9.—*Barbus capensis.* Adult, with scale enlarged; predorsal scales and every 10th scale (and approximately the 36th) in lateral line indicated; anal fin showing change in shape from young and half-grown to adult.

15–17. In large specimens the posterior barbel may be $2\frac{1}{3}$ times as long as eye.

The posterior barbel is developed at the 17–18-mm. stage, the anterior barbel at 24–25 mm.; scaling begins at 30–31 mm.

Largest specimen seen by myself: 730 mm. This specimen weighed $15\frac{1}{2}$ lbs., but specimens up to $22\frac{1}{2}$ lbs. have been reported (*Cape Argus*, Cape Town, 21/iv/38, with photo.). Specimens from about 180–200 mm. with developing roes. Males without trace of warts on head. The smallest juveniles were caught in mid-February; but spawning evidently takes place also later, and probably earlier in the summer.

Adult more or less golden or brassy above, silvery below, cheeks, opercles, and lips (especially in the "rubber-lip" forms) lemon-yellow; all fins tinged with pale gamboge or lemon-yellow. Juveniles with an irregular series of horizontally or vertically oval spots along the sides, composed largely of pigment-specks (chromatophores) of a characteristic square or oblong shape; fins as in adult.

Locality.—Olifants River, Clanwilliam Division, Cape. Long series collected by A. C. H., K. H. B., A. J. H., C. W. T., 1936–1939, together with single large specimens submitted by F. Bowker, the late Morch-Ohlsen (Warmbaths, Citrusdal), G. D. Jooste, and E. Wale.

Remarks.—The anal fin undergoes a notable change of shape during growth (fig. 9). When extended so that the last ray is horizontal, the hind margin is vertical and straight in the young and half-grown (slightly concave in very young), but in large specimens it is oblique and gently convex. In the latter the anterior margin is rather strongly curved. The first ray is always appreciably longer

Length of Fish.	1st Anal Ray extending	Least Depth of Caudal Peduncle in length of 1st Anal Ray.	When last Anal Ray horizontal, hind margin of Fin is
70 mm.	Half-way to caudal	About $1\frac{1}{4}$	Slightly concave and sloping slightly forwards (and downwards).
100 ,,	,,	,,	Straight and vertical.
200 ,,	,,	,,	,,
270 ,,	Three-quarters to caudal	$1\frac{1}{3}$	Straight and vertical (or slightly convex).
300 ,,	,,	$1\frac{1}{2}$	Gently convex and sloping backwards (and downwards).
350 ,,	To caudal	$1\frac{2}{3}$	,,
390 ,,	,,	2	,,

than the last ray, and when folded back reaches well beyond the latter; in young and half-grown it reaches to about half-way between base of last ray and bases of lower caudal rays, in the fully grown examples it reaches to or almost to the bases of the lower caudal rays.

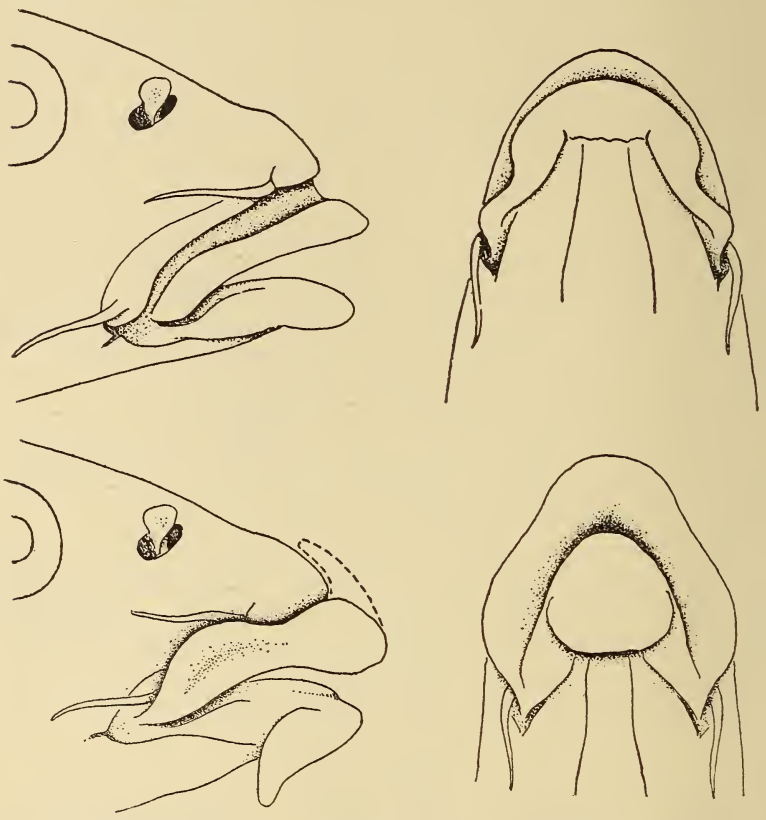


Fig. 10.—*Barbus capensis,* normal and "rubber-lip" variety. Lateral and ventral views of mouth ; the dotted line shows the extreme development of the upper lip.

The shape of the fin, which is similar in *holubi*, is essentially different, even in the early stages, from that of *serra* (*q.v.*) and other Cape species, in that the 1st ray when folded back extends beyond the end of the last ray.

Rubber-lips.—Amongst the normal *capensis* there is sometimes found a form with thick fleshy lips, both the upper and lower lip being produced in a median lobe (fig. 10). This form is known to local anglers by the very expressive name of "Rubber-lip." Except

this fleshy enlargement of the lips there is no other distinction between the forms. The smallest rubber-lip I have seen is an immature one 145 mm. in length; one 255 mm. long has been gutted; one 335 mm. long is a ♂; and the two largest, 390 and 410 mm. in length, are both ♀♀.

Worthington (Proc. Zool. Soc. London, 1929, p. 431, fig. 3) has figured the extreme variations in the lips of *B. radcliffii* and its

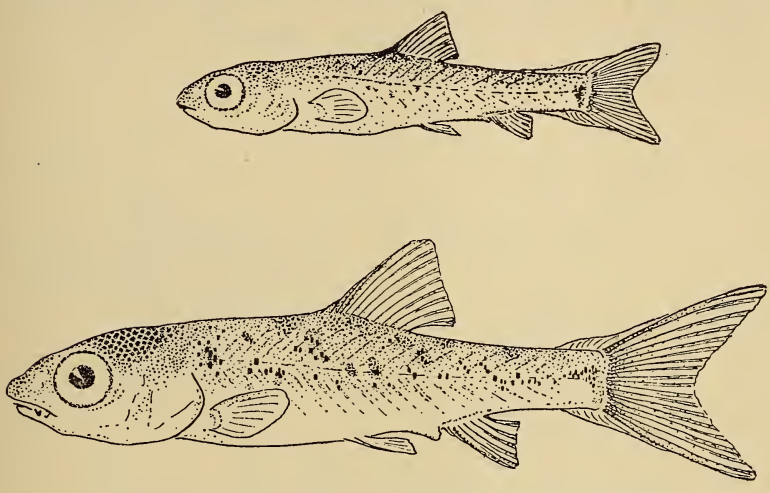


Fig. 11.—*Barbus capensis.* Juveniles, 15 mm. and 23 mm.

synonyms *bayoni* and *lobogenys*, and has stated that every gradation between the thin-lipped and rubber-lipped forms may occur in *both* sexes.

The occurrence of rubber-lips in both sexes of *capensis* has been confirmed. Of three specimens of *gunningi* in the South African Museum, 2 are ovigerous ♀♀, the third probably ♀.

Several other pairs of "species" may be suggested as being probably synonymous, e.g. *mentalis*, a synonym of *kimberleyensis*,* *sector* and *dwaarsensis* of *brucii* (this has line precedence over *sector*), and *m'fongosi* of *elephantis*.

It is a little curious that specific importance should be attached to the lip development. Day (Fishes, India, 1878–1888, p. 564, pl. 136, fig. 5, and pl. 140, fig. 1) described and figured both the thin-lipped and thick-lipped forms of *Barbus tor* (the Mahseer), and evidently assumed without question that they were one and the same

* Perhaps both these are synonyms of *gilchristi*; the latter based on a single specimen, collected together with a typical example of *holubi*. The curiously short pectoral fin of *gilchristi* may be abnormal.

species. Hora (J. Bombay Nat. Hist. Soc., 1939, xli, pp. 279–282, fig. 2 and pl. 2; *ibid.*, 1940, xli, p. 522, pl. 2; and *ibid.*, 1940, xli, p. 787) holds the same opinion. He suggests that the excessive development of fleshy lips to form a suction disc may be for the purpose of adhesion to rocks in swift currents. In conformity with this hypothesis it may be mentioned that local anglers seem to be of opinion that the rubber-lip variety of the Yellow-fish is usually found in the more rapid parts of the Olifants River. Many more observations, however, are required.

Barbus capensis.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
15	$3\frac{1}{2}$	3	e > s	e > i	No s	cales		0+7	None	Dorsal, anal, ventral fins distinct. No ventral lamella.
18	$3\frac{1}{4}$	3	e > s	e > i	,,	,,		1+8	(p)	
20	3	3	e > s	1	,,	,,		2+9	(p)	
25	3	3	e > s	1	,,	,,			p (a)	
30	3	$3\frac{1}{4}$	e > s	1	,,	,,		2+10	p (a)	p $\frac{1}{3}$ eye.
33	$3\frac{1}{4}$	$3\frac{1}{3}$	1	1	41	14–16	5–6	,,	p.a.	p $\frac{1}{2}$ eye.
35	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1	42	16	6	3+10	p.a.	
40	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1	41	16		,,	p.a.	
50	$3\frac{1}{4}$	$3\frac{1}{2}$	1	1	42	16		3+10–11		
60	$3\frac{1}{4}$	$3\frac{2}{3}$	1	1	41		10–12	4+11		
70	$3\frac{1}{4}$–$3\frac{1}{3}$	$3\frac{3}{4}$	1	$1\frac{1}{5}$						
80	$3\frac{1}{3}$	4	$1\frac{1}{5}$	$1\frac{1}{5}$						
90	$3\frac{1}{3}$	$4\frac{1}{5}$	$1\frac{1}{4}$	$1\frac{1}{5}$						
95	$3\frac{1}{3}$	$4\frac{1}{4}$	$1\frac{2}{5}$	$1\frac{1}{4}$						Type *seeberi*.
115	$3\frac{1}{3}$	$4\frac{1}{4}$	$1\frac{2}{5}$	$1\frac{1}{4}$						Type *seeberi*.
125	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{4}$			16–18			
140	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{2}{5}$	$1\frac{1}{4}$						
145	$3\frac{2}{5}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{3}$						"Rubber-lip.'
150	$3\frac{1}{2}$	$4\frac{1}{2}$	$1\frac{2}{5}$	$1\frac{1}{4}$						
160	$3\frac{2}{5}$	$4\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{3}$			22–24			
170	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$	42–45	16–18				
180	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$						♂ juv.
190	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$						
200	$3\frac{3}{4}$	$5\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$						
210	$3\frac{3}{4}$	$5\frac{1}{3}$	$1\frac{1}{2}$	$1\frac{3}{4}$						Type *seeberi*.
240	$3\frac{3}{4}$	6	2	$1\frac{4}{5}$			26–28			♂ juv.
255	$3\frac{3}{4}$	6	2	$1\frac{3}{4}$						"Rubber-lip."
300	$3\frac{3}{4}$	$6\frac{1}{4}$	$2\frac{1}{4}$	2						♂.
335	$3\frac{3}{5}$	$6\frac{1}{2}$	$2\frac{1}{4}$	2				4+12		♂ "rubber-lip."
350	$3\frac{3}{4}$	$6\frac{1}{2}$	$2\frac{1}{4}$	2						♀ "rubber-lip" and
390	$3\frac{3}{4}$	$6\frac{3}{4}$	$2\frac{1}{2}$	2						normal.
410	$3\frac{3}{4}$	7	$2\frac{1}{2}$	2			..	..	..	♂.
										♀ "rubber-lip."
490	$3\frac{3}{4}$	$8\frac{1}{4}$	3	3	44	18		4+14		♀.
600	$3\frac{3}{5}$	9	$3\frac{1}{3}$	$3\frac{1}{2}$	?	?		4+14		Gutted, and scales removed.
635	$3\frac{3}{5}$	$9\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	44	16	36	4+14		♂.
650	$3\frac{3}{5}$	$9\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{3}{4}$	42	20				♀.
730	$3\frac{1}{2}$	$9\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	43	18				♀.

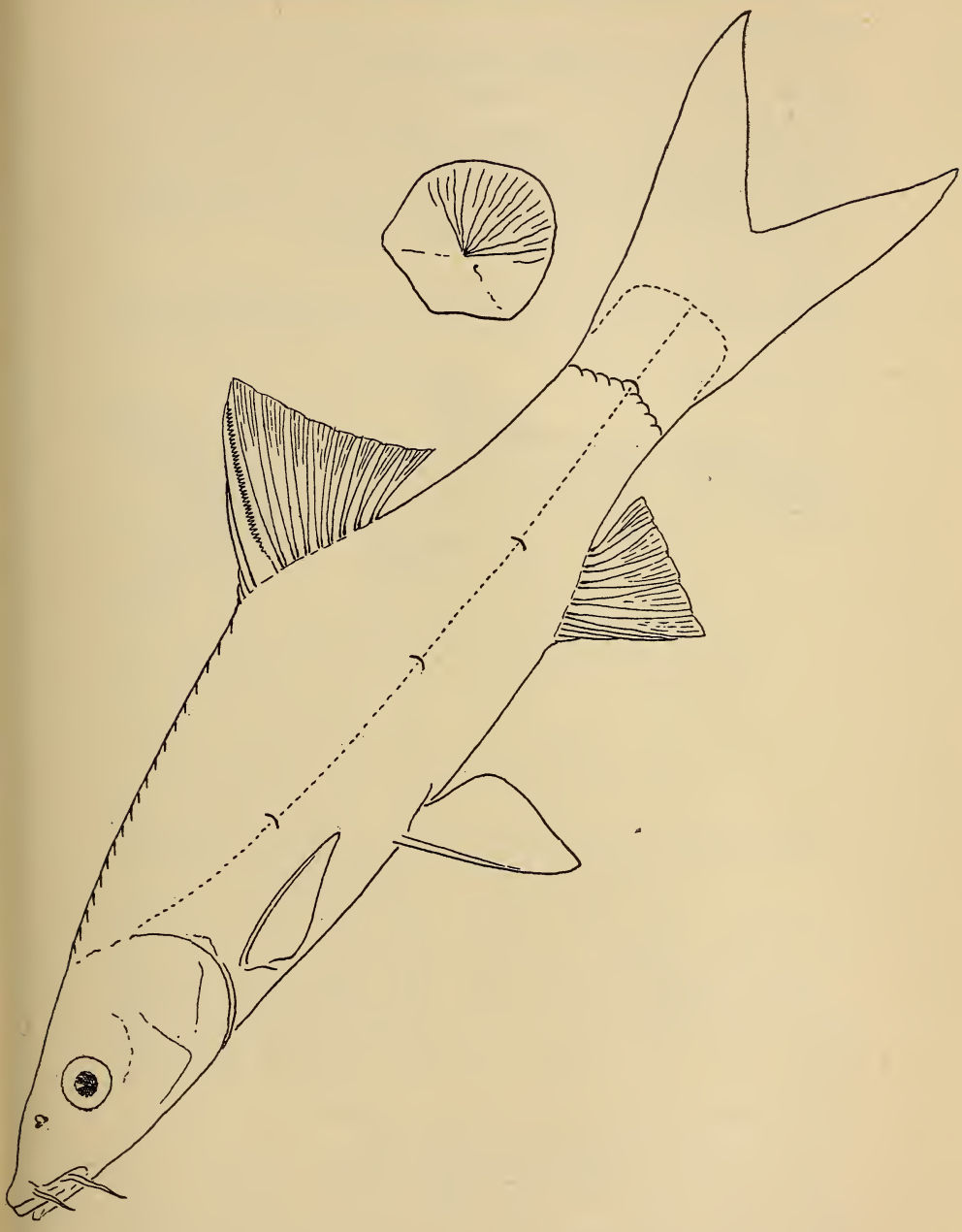


FIG. 12.—*Barbus serra.* Adult, with scale enlarged; predorsal scales and every 10th scale in lateral line indicated.

Barbus serra Peters

Saw-fin.

Figs. 12, 13.

1911. Boulenger, *l.c.*, p. 114, fig. 91.

1913. Gilchrist and Thompson, *l.c.*, p. 403, fig. 61 (part: not the two smallest of the three specimens coll. Leipoldt).

1938. Barnard, *l.c.*, p. 82.

Distinguished from *holubi* and *capensis* by the serrated dorsal spine, radiately striate scales, and shape of anal fin. The latter undergoes

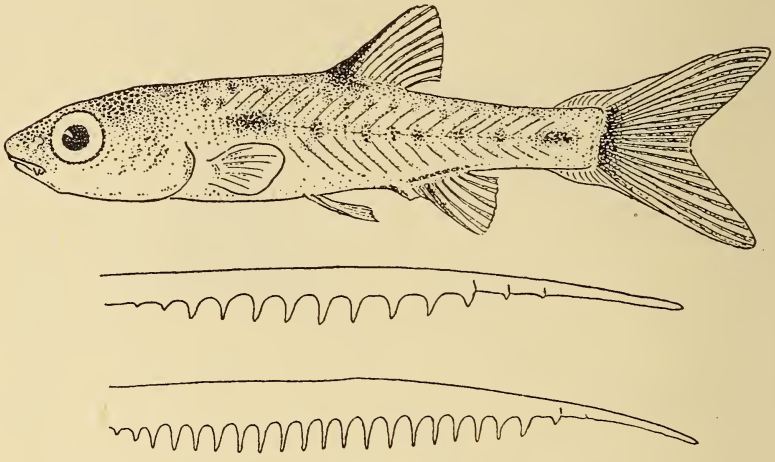


Fig. 13.—*Barbus serra*. Juvenile, 18 mm. Dorsal spine of young 40 mm. (spine 9 mm.) and 70 mm. (spine 14 mm.). (There are actually 2 rows of serrations, but only one row is shown.)

no change of shape during growth. Lower labial grooves not continuous across the chin. No warts on head in ♂.

Largest specimen examined, 380 mm. The posterior barbel is developed at about 17–18 mm., the anterior at about 20–22 mm. Scaling begins at 25–27 mm., and serration of the dorsal spine at 20 mm.

The smallest juveniles were collected in mid-February; but spawning continues later, and probably begins earlier.

Silvery greyish or drab-coloured above; dorsal, caudal, anal, and ventral fins suffused with pale orange-salmon. Juveniles with a series of dark spots, longitudinally or vertically oval, along the side, the largest being at end of caudal peduncle, often a second less

numerous series on back; these spots become more prominent after preservation; fins faintly tinged with orange or salmon.

Originally described from "Cape of Good Hope" (coll. Krebs). Like *capensis*, this distinctive species has only been found in the Olifants River, Clanwilliam Division (fig. 6); the insertion of the word "Transvaal" in Gilchrist and Thompson's monograph being a slip (p. 118).

Barbus serra.

TL	L/H	H/E	S/E	T/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
13	3½	2½	e>s	e>i	No s	cales	..	..	None	Dorsal, anal, ventral fins distinct, no ventral lamella.
15	3⅓	2¾	,,	,,	,,	,,	..	..	,,	
18	3	3	,,	,,	,,	,,	..	..	(p)	
20	3	3	,,	,,	,,	,,	..	..	p (a)	0–1 serrations on dorsal spines.
22	3	3	,,	,,	,,	,,	..	1+9	p (a)	1–2 ,, ,,
25	3	3¼	,,	1	,,	,,	..	2+9	p. a.	2–3 ,, ,,
					(or ante	a few riorly)				
27	3	3⅓	1	1	40	18	4	2+10	p. a.	4–5 ,, ,,
30	3	3⅓	1	1	41	18–20	4	3+10	..	5–6 ,, ,,
35	3⅕	3½	1	1	41	(18) 20	..	5+11	..	7–8 ,, ,,
40	3¼	3½	1⅕	1⅕	42		4	5+11		
45	3¼	3½	1⅕	1⅕	42		..	,,		
50	3¼	3¾	1¼	1¼			..	5+12	..	14 serrations.
55	3¼	3¾	1¼	1¼			4–5			
65	3¼	4	1¼	1¼						
70	3¼	4¼	1⅓	1¼			..	6+12		
75	3¼	4⅓	1⅖	1¼			5–6			
95	3¼	4½	1½	1¼						
100	3⅓	4⅔	1½	1¼		20				
110	3⅓	4⅘	1¾	1⅓						
125	3½	5	1⅘	1½			7–8			
140	3½	5⅔	2	1½						
170	3⅖	5⅔	2	1½	41–44					
210	3½	6	2¼	1¾			10–12	6+12		
260	3½	6	2¼	1¾			..	..	..	♂.
280	3½	6½	2½	2			..	..	..	♂.
300	3½	7½	2¾	2½			15	..	..	♂.
320	3½	7½	3	2½			..	..	..	♂.
340	3½	8	3	3			..	..	..	Spent ♀.
350	3½	8	3⅓	3		20–22	..	..	..	♂.
360	3½	8¼	3½	3⅕			..	..	..	♂.
380	3½	8½	4	3¼			17	6+12	..	♂.

Barbus paludinosus Peters

Fig. 14, *a*, *b*.

1911. Boulenger., Cat. Fw. Fish. Afr., ii, p. 115, fig. 92.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 404, fig. 62.

1935. Fowler, Ann. Transvaal Mus., xvi, p. 265, fig. 9 (*tsotsorogensis*).
1936. Trewavas, Novit. Zoolog., xl, p. 66.
1936. Pellegrin, Arc. Mus. Bocage, Lisbon, vii, p. 53.
? 1937. J. L. B. Smith, *l.c.*, p. 125, pl. 30, fig. 4.

A very fine series of over 200 specimens of all sizes was collected by Dr. Hesse and Mr. Thorne in the Gt. Fish River at Aiais, South West Africa, Nov. 1936. Although strictly speaking the locality is outside our area, it seems desirable to include some details of the young stages of this species, particularly for comparison with the following species *hospes*.

This series shows that the posterior barbel develops at about the 19–20 mm. stage, the anterior one at about 29–30 mm. The scales are developed at about 23 mm., with 3 striae (radiating); at 68 mm. there are about 12 main striae and several "intercalaries" (15–18 in all).

The first serrations on the 3rd dorsal spine appear at about 22–23 mm., increasing in number until in the adult there are about 18 serrations, closely set and all curving downwards towards base of the spine. The tip of the spine is delicate and easily broken. In the adult the 2nd spine is not more than $\frac{1}{3}$ length of the 3rd.

The dorsal fin from the earliest stage onwards has a characteristic elevated shape, the hind margin being approximately vertical when the fin is extended (3rd spine at an angle of 60° with the long axis of body).

The lowermost gill-rakers (about 6) are knob-like and rather stout, not lanceolate. (In the Gibeon and Etosha Pan specimens in S.A. Museum all the gill-rakers are slender.)

External sexual differences are not apparent, no warts or mucous pores being developed on the head in ♂, and the pectoral fin not differing in length. Males are adult at about 55 mm., and females at about 62 mm. (Aiais series).

Adults show a faint creamy-yellow tinge on the fins, including the caudal, but no red spots.

A series from Middelburg, Transvaal (Limpopo system), includes specimens from 20 mm. in length upwards (only the larger ones were recorded by Gilchrist and Thompson), and fits in with the table drawn up from the Aiais series.

In addition to the localities mentioned by Gilchrist and Thompson, the South African Museum has material from Ovamboland and the Etosha Pan, S.W.A.; from the Gt. Fish River at Gibeon, S.W.A.; from the Orange River, lower section at Goodhouse, and middle section above the Aughrabies Falls and at Upington; from the Dry Hartz River at Taungs, and Vaal River at Warrenton.

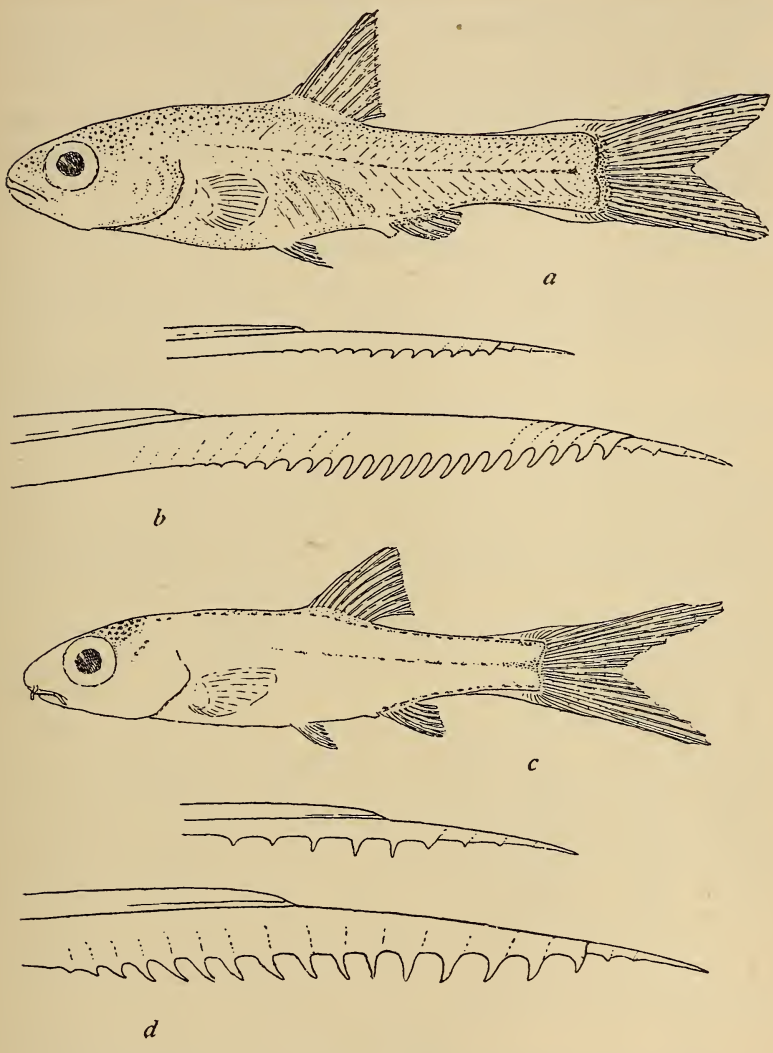


Fig. 14.—*Barbus paludinosus: a.* Juvenile, 12 mm. Gt. Fish River, South West Africa. *b.* Dorsal spines of specimens 35 and 68 mm. in length. *Barbus hospes: c.* Juvenile, 18 mm. Goodhouse, Orange River. *d.* Dorsal spines of specimens 32 and 63 mm. in length. (Only one row of serrations on the spines is shown.)

I have examined specimens of *tsotsorogensis* Fowler; it is merely another synonym of *paludinosus*.

Recent investigations appear to show that this species is absent from the *southern* tributaries of the Orange River.

J. L. B. Smith (1937) says it is common in the Grahamstown and Eastern Cape districts. There are no previous records from this region and the identification should be checked.

Barbus paludinosus.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
11	$3\frac{1}{5}$	3	e > s	1	No s	cales	..	..	None	Dorsal and anal fin rays distinct. Dorsal spine not serrate.
13	$3\frac{1}{5}$	3	e > s	1	,,	,,	..	..	,,	
15	$3\frac{1}{5}$	3	e > s	1	,,	,,	..	..	,,	
18	$3\frac{1}{4}$	3	e > s	1	,,	,,	..	..	,,	
20	$3\frac{1}{4}$	3	e > s	1	,,	,,	..	8	(p)	
23	$3\frac{1}{4}$	$3\frac{1}{5}$	e > s	1	32	14	..	8–9	(p)	Dorsal spine serrate.
25	$3\frac{1}{4}$	$3\frac{1}{4}$	e > s	$1\frac{1}{5}$	33	16	3	,,	p	
28	$3\frac{1}{4}$	$3\frac{1}{4}$	e > s	$1\frac{1}{4}$			..	,,	p	
30	$3\frac{1}{4}$	$3\frac{1}{4}$	e > s	$1\frac{1}{4}$			3–4	,,	p (a)	
32	$3\frac{1}{4}$	$3\frac{1}{3}$	e > s	$1\frac{1}{4}$			..	1+9	p (a)	
35	$3\frac{1}{2}$	$3\frac{1}{2}$	e > s	$1\frac{1}{3}$			..	2+9	p. a.	
38	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$			4			
40	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$						
42	$3\frac{2}{3}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$			4–5			
45	$3\frac{3}{4}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	33–36	16				
48	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$			7–8	2+9	..	♂ juv.
52	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			..	2+10	..	♂♂ juv.
55	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			..	..	..	♂♂.
58	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			9	..	..	♂♂.
60	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$				3+10	..	♂♂.
62	4	$3\frac{2}{3}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			..	..	..	♀ ova.
65	4	$3\frac{3}{4}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$			10	..	..	♀.
68	4	$3\frac{3}{4}$	1	$1\frac{1}{3}$			10–11	..	..	♀.

Barbus hospes Brnrd.

Fig. 14, *c*, *d*.

1938. Barnard, *l.c.*, p. 85.

Depth of body (largest specimens) about 4 in length (excluding caudal fin); length of head 3 (juv.), $3\frac{2}{3}$ (adult) in length; eye 3 (juv.), $3\frac{1}{2}$ (adult) in length of head, 1–$1\frac{1}{3}$ in interorbital width, and, from the 30-mm. stage upwards, subequal to snout. Snout rounded, mouth inferior, lower labial grooves interrupted across chin; 2 pairs of

barbels, both appearing simultaneously at about the 15-mm. stage, subequal to one another, and from about the 32-mm. stage upwards subequal to eye-diameter.

D iii. 7. 1st spine slightly nearer to end of middle caudal rays than to tip of snout, 2nd spine about half length of 3rd, 3rd spine in adult thickened, serrated from near base, about 14 serrations, those on basal half directed apically, those on distal half directed towards base of spine, serrations fewer in young and half-grown; margin of fin forming an angle of about 60° with long axis of body. A iii. 5. Pectoral not reaching to ventral (♂). Ventral spine arising in advance of 1st dorsal spine, base of last ray about below 3rd dorsal spine. Caudal elongate, length of longest rays 3 times in length of body (excluding caudal fin) in juv., to $2\frac{3}{4}$ or $2\frac{2}{3}$ in adult.

Gill-rakers in adult 2+6 (7) on anterior arch, the 3–4 lowermost ones short and broad.

Scales developed at about the 22–23-mm. stage, radiately striate, 3 striae in juv. to 6–7 in adult; l.l. 37–39, 16 (14 in youngest scaled stage) around caudal peduncle, 6 between 3rd dorsal spine and l.l., 4 between ventral spine and l.l. (the l.l. scale not counted), 5 between l.l. and anal spines, predorsal about 21.

Top of head and snout in the largest specimens thickly sprinkled with minute white pimples (about 4–5 per sq. mm.); all these are ♂♂, no adult ♀ was collected.

Colour (as preserved): silvery, green-brown above, belly in the largest specimens with an orange-salmon tinge, fins pale. According to the collectors, no markings or red spots at fin-bases were present in the freshly caught specimens. The specimens are notably paler in all stages than the specimens of *paludinosus* caught, and preserved, at the same time.

Locality.—Orange River, at Goodhouse, Namaqualand (A. J. Hesse and C. W. Thorne, Nov. 1936).

This species is distinguished by the particular character of the serrated 3rd dorsal spine, the long caudal fin, and the *simultaneous* development of the two pairs of barbels.

From *paludinosus*, with which it was associated, it is easily distinguished in all stages by the shape of the dorsal fin, serration of 3rd dorsal spine, and the length of the anterior barbel. In very young stages the serration of the dorsal spine may not be very distinctive, but the two other characters just mentioned, together with the length of the caudal fin, enable the species to be separated without difficulty.

The serration of the dorsal spine differs from that of any other

South African species in that the proximal serrations curve towards the apex of the spine.

Mr. A. C. Harrison has examined the scales and finds that there are a few weak striae (radiating) in the exposed (posterior) field, but none in the anterior field: "The entire absence of radii in the anterior field and the weakness of those in the posterior field gives the scales a facies differing markedly from that of other small *Barbus* scales examined; the concentric circuli about the focus are without breaks or scalloping in consequence of this absence of radiating striae."

The specific name in allusion to "Goodhouse," the name of the farm on the south bank of the Orange River at Raman's Drift, owned by the hospitable Mr. C. Weidner.

Barbus hospes.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
14	3	3	e > s	1	No s	cales	..	5	None	Dorsal and anal fin rays distinct.
15	3	3	e > s	1	,,	,,	..	..	(p) (a)	
16	3	3	e > s	1	,,	,,	..	..	p. a.	
18	3	3	e > s	1	,,	,,	..	5–6	p. a.	Dorsal spine 1–2 serrations.
20	3	3	e > s	1	,,	,,	..	..	..	,, ,, 3 ,,
23	3	3	e > s	1	37	14	..	1+5–6	..	,, ,, 4 ,,
25	3⅛	3⅕	e > s	1	37	16	..	1+6	..	,, ,, 4–5 ,,
28	3¼	3¼	e ≡ s	1	38	16	..	1+6	..	,, ,, 5 ,,
30	3⅓	3⅓	1	1⅓	37	16	3	..	..	,, ,, 5–6 ,,
32	3⅓	3½	1	1⅓	37	16				
52	3½	3½	1	1⅓	38	16	4–5	6+6	..	♂ with pimples.
55	3⅔	3½	1	1⅓	37	16	5–6	..	..	♂ ,,
60	3⅔	3½	1	1⅓	39	16	6–7	2+6	..	♂ ,,
63	3⅔	3½	1	1⅓	38	16	7–8	2+7	..	♂ ,,

Barbus calidus Brnrd.

Clanwilliam Red-fin; Rooivlerk.

Fig. 15, *a–c.*

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 404 (part *serra* non Peters—the two smallest of the three specimens coll. Leipoldt).

1938. Barnard, *l.c.*, p. 86.

Depth of body 4½ (juv.), 4 or 3¾ (adult), length of head 3 (juv.), 3¾ (adult), in length of body (excluding caudal fin). Eye 3 (juv.), 3½ (adult) in length of head, subequal to snout and to interorbital

width in adult, but greater than these in juveniles. Snout rounded, projecting slightly beyond mouth. Lips thin, the lower labial grooves interrupted for a short distance medianly on chin. Two barbels on each side, the posterior equal to eye-diameter, the anterior

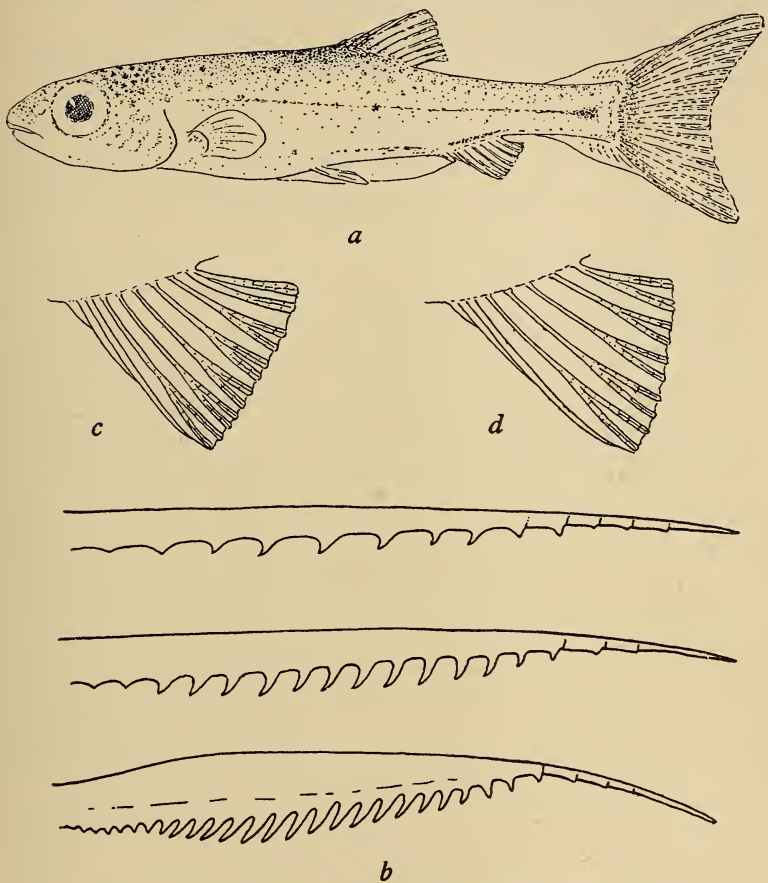


Fig. 15.—*Barbus calidus: a.* Juvenile, 13 mm. *b.* Dorsal spines of specimens 25, 40, and 70 mm. in length (length of spine 5·3, 8, and 13 mm. respectively). (Only one row of serrations on the spines is shown.) *c.* Anal fin. *Barbus phlegethon: d.* Anal fin.

slightly less. Gill-rakers 2+6 (juv.), 2+7 or 8 (adult) on anterior arch. No tubercles on head in ♂, but minute pimples often visible in both sexes.

D iv. 7. The 1st spine about midway between the last scales on caudal peduncle and the centre or front margin of eye; 3rd spine

about $\frac{1}{3}$ length of 4th, the latter not exceeding $\frac{3}{4}$ head length; 4th spine serrate in the youngest specimens (17 mm.), with few and rather widely spaced serrations; in adult enlarged and with numerous strong, closely set serrations pointing downwards towards base of spine. A iii. 6 (–7). Pectoral reaching to or nearly to base of ventral spine in both sexes. Last ray of ventral fin below, or even slightly in advance of, the 1st dorsal spine. Caudal peduncle about $1\frac{1}{2}$ times as long as deep.

Scales radiately striate, striae 4–5 (juv.), 12–14 (adult); lat. line 36–37 (34–38), tr. 6 between dorsal spines and lat. line, 3 between latter and base of ventral spine; around caudal peduncle 12 in specimens up to about 30 mm., 14 in those up to about 55 mm., and 16 in adults. Predorsal about 15.

The posterior barbel is developed at 13–14 mm., the anterior at 17–18 mm. Scaling begins at about 18 mm.

Up to 93 mm. (tip of snout to end of middle caudal rays). Greenish-brown above, silvery with pale yellowish tinge on belly; in specimens from 21 mm. in length upwards red patches are developed in both sexes at bases of the dorsal and anal fins, and in the axils of pectoral and ventral fins; caudal fin also frequently with a pinkish tinge. In preserved specimens a dark lateral stripe becomes visible, more or less broken up into several spots posteriorly; juveniles with dark spots along side and back (somewhat similar to *serra* and *capensis*).

Localities.—Olifants River, Clanwilliam (C. J. Leipoldt, 1897, and R. M. Lightfoot, 1898); Jan Diesel's River, Clanwilliam (K. H. B. and C. W. T., 1936); Tratra River, Wupperthal, Clanwilliam District (K. H. B. and C. W. T., Sept. 1936); Boontjes River, Citrusdal (A. J. H. and C. W. T., Nov. 1936; A. C. H., K. H. B., and C. W. T., April 1937 and 1938); Keerom (S. of Citrusdal), Olifants River (A. C. H., K. H. B., and C. W. T., April 1938, February 1939).

Remarks.—The three specimens collected by C. J. Leipoldt in 1897 were recorded as *serra* by Gilchrist and Thompson, but only the largest one is that species. The error is quite pardonable, as at that time the presence of another species was not suspected and no long series of any species was available to the above collaborators.

Juveniles were obtained at the end of September, in November, February, and early April.

Distinguished from the other Red-fin found in the Olifants River (*phlegethon*), and also from all other Red-fin species, by the serrated dorsal spine. The shape of the anal fin also distinguishes it from *phlegethon* (fig. 15, *d*).

Named after the brightness of the red patches, and the heat of the Olifants River valley in summer time.

Both the Jan Diesel's River and the Tratra River are in the Olifants River system, the former flowing direct into the Olifants River at Clanwilliam, the Tratra flowing into the Doorn and then into the Olifants. The Boontjes flows into the Olifants River between Citrusdal and Clanwilliam (figs. 1 and 6).

Barbus calidus.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
11	3¾	2½	e < s	e < i	No scale	s	..	None	Dorsal and anal fins distinct.
12	3½	3	,,	,,		,,		0+3	,,	Ventral fins free.
13	3½	3	,,	,,		,,		..	(p)	No ventral lamella.
14	3½	3	,,	,,		,,		1+4	(p)	
15	3	3	,,	,,		,,				
16	3	3	,,	,,		,,		..	p	Dorsal spine 0–1 serration.
17	3	3	,,	,,		,,		2+6	p (a)	
19	3	3	,,	,,		,,		..	p (a)	2–3 serrations.
21	3⅕	3	,,	,,	34	12	4	..	p a	Red patches begin.
25	3⅕	3	,,	,,	35	12	4–5	,,	..	7 serrations.
27	3⅕	3	,,	,,	36	12	..	2+7		
30	3⅕	3	,,	,,	36	12	6–8	,,		
32	3⅕	3⅙	,,	,,	37	12	..	,,	..	10 serrations.
39	3¼	3⅙	,,	,,	36	14	..	,,		
43	3¼	3⅕	1	1	37	14	..	,,		
50	3⅓	3¼	1	1	37	14	..	,,		
55	3⅓	3⅓	1	1	36	14	10	,,		
68	3½	3⅓	1	1	37	14–16	..	2+7–8	..	♀♀ ova.
70	3½	3⅓	1	1	37	16	..	,,	..	♀ ova.
75	3½	3½	1	1	37	16	12	,,		
80	3¾	3½	1	1	36	16	..	,,	..	♂.
88	3¾	3½	1	1	36	16	..	,,	..	♀ ova.
93	3¾	3½	1	1	38	16	14	,,	..	♂.

Barbus andrewi Brnrd.

Andrew Smith's White-fish; Berg and Breede River White-fish; Witvis.

Figs. 16, 17.

1897. Weber, Zool. Jahrb. Abt. Syst., x, p. 151 (part *capensis*, non A. Smith: the French Hoek and Paarl specimens, but not the juv. from Viol's Drift).

1911. Boulenger, *l.c.*, p. 123, fig. 100 (part *capensis*, non A. Smith: all specimens except Smith's type) (figure shows only 7 dorsal rays).

1913. Gilchrist and Thompson, *l.c.*, p. 412, fig. 70 (*capensis*, non A. Smith) (fig. after Boulenger, showing 7 dorsal rays).

1937. J. L. B. Smith, *l.c.*, p. 125, pl. 30, fig. 1 (*capensis*, non A. Smith).

1937. Barnard, Ann. Mag. Nat. Hist. (10), xix, p. 305.

1938. *Id.*, *ibid.* (11), ii, p. 82.

This species and *serra* are the only two *large*-sized *Barbus* with *radiately* striate scales in the region under discussion. The Saw-fin (*serra*), however, is easily distinguished by the much stronger serration of the dorsal spine, only 5 branched anal rays, and the scale-count.

The dorsal fin formula is given as D iii. 8; but there are actually 4 spines, the true 1st spine being obscured in half-grown and adult examples. In large specimens the dorsal spine is often less strongly developed, relatively, than in younger specimens, and the serrations become nearly obsolete.

The posterior barbels are developed at about 21–22 mm., the anterior at about 24–25 mm.; scaling begins at about 24–25 mm., and from about 25 mm. the dorsal spine serrations begin to develop.

Although published records give 380 mm. as the length to which this species grows, local farmers and anglers report that it reaches a length of at least 2 feet (600 mm.); the largest I have seen was a ♀ $20\frac{3}{4}$ inches (525 mm.) in length, weighing 6 lbs. 7 ozs., caught in the Brand Vlei Dam at Worcester by Mr. H. Botha in November 1941, and forwarded to the South African Museum by Mr. Perkins who stated that it was a record for the Worcester Trout Anglers Association.

The sexes can be distinguished by the roes at a length of about 160 mm., and sexual maturity is attained probably at about 200 mm. There is no sexual difference in the length of the pectoral fin. No warts are developed on the head in the ♂, but in both sexes there are numerous minute pimples on the top of the head, and extending over the scales as far back as the dorsal fin. When a fish is taken out of the water and allowed to dry, these pimples are quite visible to the naked eye, and can be felt with the finger as a slight roughness. After preservation they become white, but are not to be seen if the mucous covering has been rubbed off; where the mucus is lost minute pits can be seen on the top of the head (cf. *Labeo*).

The fishes mass for spawning at the head of a stony pool or run below rapids from the middle of November onwards into January. On 27th November 1938 Messrs. F. G. Chaplin, A. C. Harrison, C. W. Thorne, and the writter netted and "stripped" several ripe ♂♂ and

♀♀ in the Berg River at Drakenstein. Mr. Chaplin took the fertilized eggs to the Jonkershoek Fish Hatchery, where the fry hatched on 2nd December. Juveniles were preserved at various stages, and have been used to check observations on juveniles caught free in the river.

Coloration, up to about 100 mm. in length, silvery, with irregular dark spots or vertical bars, more marked in the younger stages; larger specimens are duller especially on the back, with the centre of each scale pale lemon-yellow, giving the freshly caught fish a distinct yellow tinge; old examples are dull bronzy-green or brassy, becoming paler yellowish and more or less silvery on the belly; all the fins pale rosy or dull orange-salmon, including the caudal, but usually only the anterior part (if at all) of the anal fin; quite small specimens of 30–35 mm. begin to show the pink tinge on the fins, which often becomes intensified in breeding ♂♂.

Dr. Andrew Smith had examples of this fish from the Breede River, but unfortunately he confused them with examples from the Olifants River. The Berg and Breede River White-fish does not correspond with his description of *capensis* (with *longitudinally* striate scales), nor with his type specimen of *capensis* in the British Museum. Consequently a new name had to be instituted (1937).

B. andrewi is found throughout the Berg and Breede river-systems, but has not been recorded from elsewhere (fig. 6). Gilchrist and Thompson recorded a specimen emanating from the Durban Museum, but there is no evidence to show that it was actually caught in Natal.

This is the only species of *Barbus* which is found in two major catchment basins separated by well-defined topographical barriers.

On p. 42 of Report, i (1926), Hey says: "It is stated that 35–40 years ago the Wittevis was unknown in the Breede River or its tributaries. It is suggested that this fish made its way from the Berg River by means of a furrow connecting the Small Berg and the Witte River" [near Wellington]. The first statement is refuted by Andrew Smith recording *Barbus "capensis"* (the fact that he confused two species under the same name has no significance in this connection) from the Breede River; secondly, only one furrow is known and it *leads off from the Witte River* (a tributary of the Breede River) and has such a precipitous fall *down to the Krom River* (tributary of the Berg River) that any migration *up*-stream from the latter to the former is out of the question.*

* This furrow was completed in 1860, and constitutes a "counter act of piracy through human agency," because the Witte River at one time flowed into the

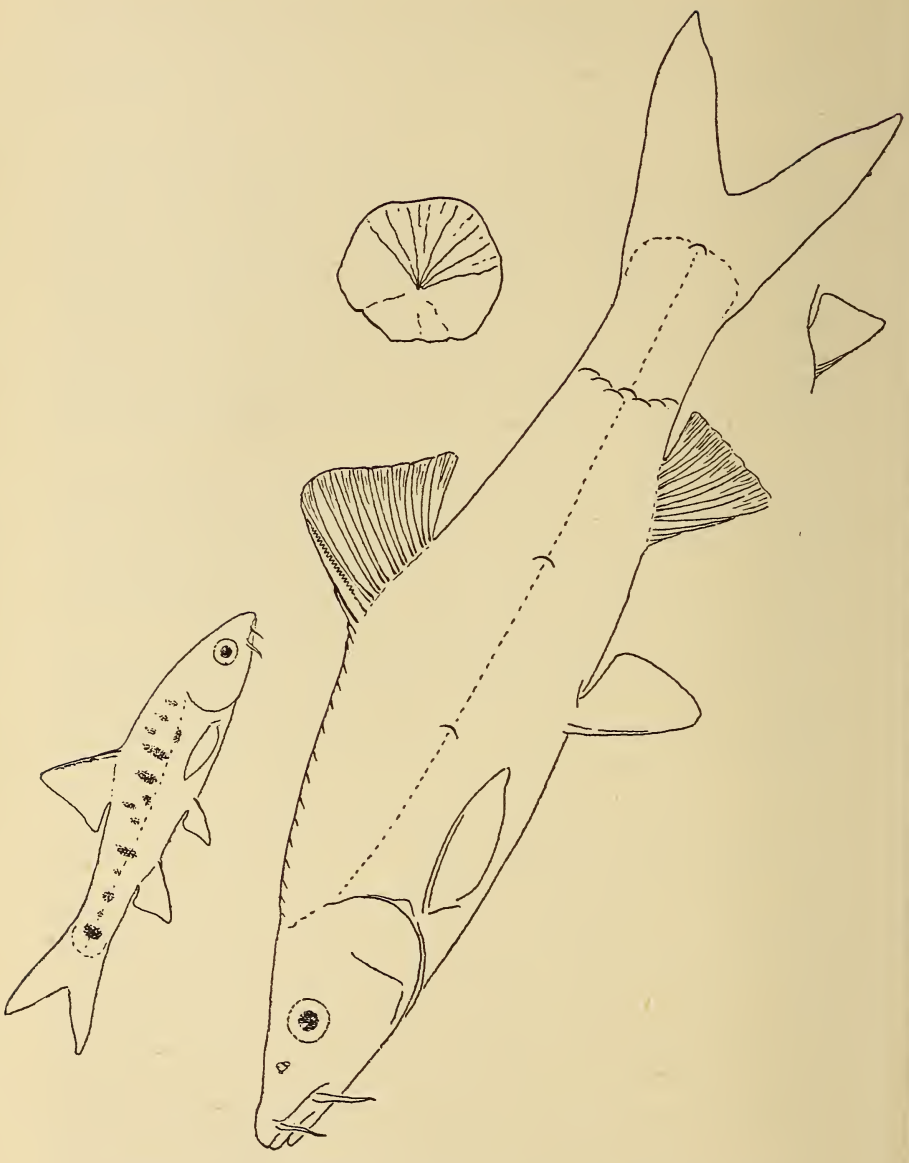


FIG. 16.—*Barbus andrewi.* Young, showing markings, and half-grown (nat. size); in the latter the predorsal scales and every 10th scale in lateral line are indicated; scale enlarged; anal fin of an intermediate sized example showing change in shape between young and adult.

It is possible that the early colonists transported the white-fish from the Berg into the Breede River, but the suggestion does not seem altogether plausible and is not based on any historical record.

At the present day the lowest and least accentuated watershed between the Berg and Breede systems lies between the sources of the Little Berg River and the main Breede River in the Tulbagh–Wolseley area (fig. 1, ×). Heavy flooding might have made intercommunication possible. But, on the other hand, the topographic evidence

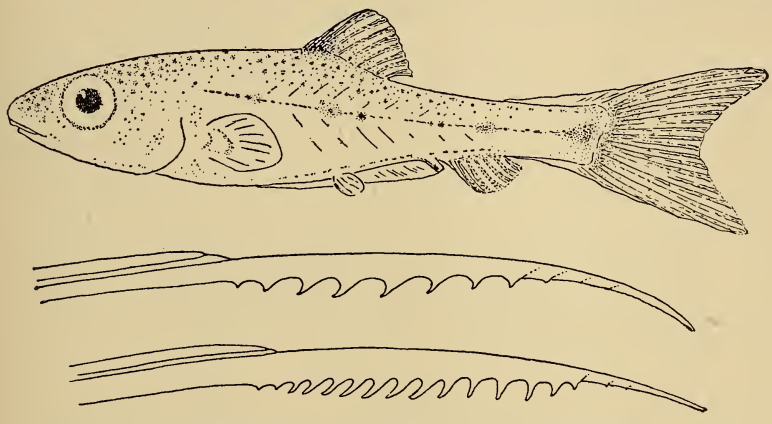


Fig. 17.—*Barbus andrewi*. Juvenile, 14 mm. Berg River. Dorsal spines of specimens 40 mm. and 70 mm. in length (length of spines 8 and 13 mm. respectively). (Only one row of serrations on the spines is shown.)

shows that in former times the Little Berg River captured the true headwaters of the Breede River.

Aberrations.—Two specimens have been examined which agree in nearly all respects with typical specimens; but if submitted to a systematist without any data, or long series of typical specimens for comparison, they would probably be regarded as a distinct, undescribed species.

One of 85 mm. length was caught in the Witte River valley (a tributary of the Breede River). The last dorsal spine is slender, flexible, and non-serrated. There are only 2+5 gill-rakers on the anterior arch.

One of 95 mm. length was caught among a shoal of typical *andrewi*

Berg River, but was captured by the energetic tributary of the Breede River cutting up through Bain's Kloof. See River Piracy, The Origin of the Witte River Furrow, by B. L. [Bernard Lewis], Journ. Mountain Club S. Afr., No. 38 for 1935, p. 21, Cape Town, 1936.

in the River Zonder End by Mr. Thorne and myself. It was not distinguishable at the time of capture, or after preservation, by coloration. Like the first specimen, it has the last dorsal spine slender and non-serrate, and the gill-rakers are slightly fewer, 3+8 (normal for these sizes: 5 or 6+10, see table *infra*).

Barbus andrewi.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	d.sp.s.	Sex and Remarks.
12	$3\frac{3}{4}$	$2\frac{3}{4}$	e > s	e>i	N	o scale	s	0+4	None	..	Dorsal formed, anal and ventrals forming.
14	$3\frac{1}{2}$	3	,,	,,		,,		..	,,	..	Dorsal and anal formed, ventrals free.
15	$3\frac{1}{3}$	3	,,	,,		,,		..	,,		
18	$3\frac{1}{4}$	3	,,	,,		,,		1+6	,,		
21	3	3	,,	,,		,,		1+8	,,	None	
23	3	$3\frac{1}{2}$	1	,,		,,		1+9	(p)	0–1	
25	3	$3\frac{1}{2}$	1	,,	38	14–16	3	2+9	p (a)	2–4	
30	3	$3\frac{1}{2}$	1	1	38	16	3–4	3+10	p a	5–7	
35	3	$3\frac{1}{2}$	1	1			,,	,,	..	6–8	
40	3	$3\frac{1}{2}$	$1\frac{1}{5}$	$1\frac{1}{6}$			,,	4+10	..	8–10	
45	3	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{5}$			4	5+10	..	9–12	
50	3	4	$1\frac{1}{4}$	$1\frac{1}{4}$			4–5	,,	..	10–13	
55	$3\frac{1}{5}$	$4\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{1}{4}$			5	,,	..	12–14	
65	$3\frac{1}{4}$	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{3}$			,,	,,	..	13–16	
75	$3\frac{1}{3}$	$4\frac{1}{2}$	$1\frac{2}{3}$	$1\frac{1}{2}$			5–6	,,	..	14–16	
85	$3\frac{1}{3}$	$4\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$			6	,,			
95	$3\frac{1}{3}$	5	2	$1\frac{1}{2}$			6–7	6+10	..	15–18	
105	$3\frac{1}{2}$	5	2	$1\frac{1}{2}$			,,	,,			
115	$3\frac{1}{2}$	$5\frac{1}{3}$	2	$1\frac{1}{2}$			..	,,	..	17–20	
125	$3\frac{1}{2}$	$5\frac{1}{2}$	2	$1\frac{1}{2}$			9–10	,,			
135	$3\frac{1}{2}$	$5\frac{1}{2}$	2	$1\frac{2}{3}$			..	,,			
145	$3\frac{1}{2}$	6	$2\frac{1}{2}$	2	38–40 (41)	16	12	6+11	..	19–22	
155	$3\frac{1}{2}$	$6\frac{1}{4}$	$2\frac{1}{2}$	2			..	,,			
170	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	2			..	,,			
180	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{3}$			12+	,,	..	25–26	♂.
195	$3\frac{1}{2}$	$6\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{3}$			..	,,			
225	$3\frac{1}{2}$	$7\frac{1}{2}$	3	$2\frac{1}{2}$			..	,,			
245	$3\frac{1}{2}$	$7\frac{1}{2}$	3	$2\frac{1}{2}$			..	,,			
295	$3\frac{1}{2}$	8	$3\frac{1}{2}$	$2\frac{2}{3}$			..	,,			
305	$3\frac{1}{2}$	$8\frac{1}{4}$	$3\frac{1}{2}$	3			12+	,,	..	ca. 30	♀ ova.
340	$3\frac{1}{2}$	$8\frac{1}{4}$	$3\frac{1}{2}$	3			..	,,	..	..	♂.
350	$3\frac{1}{2}$	$8\frac{1}{4}$–$8\frac{1}{3}$	$3\frac{1}{2}$	3			14+	,,	..	..	♂♀ Spine often slender and serrations feeble.
365	$3\frac{1}{2}$	$8\frac{1}{3}$	$3\frac{1}{2}$	3			..	,,	..	..	♂ Spine often slender and serrations feeble.
525	$3\frac{1}{5}$	$10\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{3}$	38	16	14+	6+12	..	..	♀ serrations obsolete.

Barbus burchelli A. Smith

Burchell's Red-fin; Rooivlerk.

Fig. 18, *a*.

1841. A. Smith, Illustr. Zool. S. Afr. Fish., pl. xi, fig. 1.

1897. Weber, *l.c.*, p. 152 (part *anoplus*, the juv. from French Hoek).

1911. Boulenger, *l.c.*, p. 146, fig. 122 (part: nos. 1–3, but not the juv. from Deelfontein).

1911. *Id.*, *ibid.*, p. 147, fig. 124 (*burgi* = ♂).

1911. *Id.*, *ibid.*, p. 178, fig. 156 (*afer* from Cape Town, non *afer* Peters).

1913. Gilchrist and Thompson, *l.c.*, p. 417, fig. 75 (part, not the Robertson specimens).

1913. *Id.*, *ibid.*, p. 419, fig. 76 (*burgi*).

1913. *Id.*, *ibid.*, p. 430, fig. 88 (*afer*, after Blgr., non Peters).

1938. Barnard, *l.c.*, p. 82.

[Not *burchelli* Weber, *l.c.*, p. 153. Oudtshoorn and Laingsburg = *asper*.

Probably not *burchelli* Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, 1934, p. 429. Natal.

Probably not *burgi* Pellegrin, Arquiv. Mus. Bocage. Lisbon, vii, 1936, p. 55. Angola.

Probably not *burchelli* J. L. B. Smith, *l.c.*, 1937, p. 127, pl. 30, fig. 2.]

A smallish species, growing to a length of 117 mm., and very closely allied to *vulneratus*. Its most remarkable feature is the belated appearance of the anterior pair of barbels.

There are actually 4 dorsal spines, but the true 1st is very small and can only be seen moderately easily in juveniles; in adults it becomes obscured, and for practical purposes the species is reckoned as having only 3 dorsal spines, the last being thin and flexible, without serrations.

The spine of the ventral fin arises at the vertical from the 2nd (*i.e.* penultimate) dorsal spine. The ventral fins become free at a slightly earlier stage than in *vulneratus*.

The scaling begins at about 17–18 mm. The number of lateral line scales may increase slightly in adults, but the normal number around the caudal peduncle is 12. One or two extra scales may be interpolated at the forward end of the peduncle in large specimens. Predorsal scales 13–15, usually 15. The lateral line tubules are complete except in very rare cases.

The posterior pair of barbels is developed at about the 17–18 mm. stage. The development of the anterior barbels is delayed until a quite unusually late stage in life, viz. 52–53 mm. I have seen two specimens of 62–64 mm. in which the anterior barbels were either absent or mere points, easily overlooked. This explains the identification of young specimens (having only the posterior pair of barbels) as

Fig. 18.—*Barbus burchelli: a.* Juvenile, 13 mm. Berg River. *Barbus vulneratus: b, c.* Juveniles, 11 mm. and 15 mm. Genadendal, River Zonder End.

anoplus by Weber (1897).* The anterior barbel always remains relatively small, scarcely ever equalling the diameter of the eye.

The pectoral fin shows sexual differences. In the young, and throughout life in the ♂, it reaches to, or almost to, the base of the ventral fin (*burgi* Blgr.). In the adult ♀ it is appreciably shorter and does not reach to the ventral fin; the gap between the end of the pectoral and the base of the ventral is at least $\frac{1}{3}$ the length of the pectoral fin.

Breeding ♂♂, about 80 mm. in length (one of 62 mm. examined),

* I have seen these specimens.

develop conical tubercles on the snout and top of head. In preserved specimens these tubercles are easily rubbed off, and possibly they are naturally caducous after the breeding season.

In juveniles about 20–35 mm. there are obscure dark spots on the body, in addition to the line of pigment along the sides; later the lateral stripe usually becomes more distinct, and it may swell out in places forming more or less disconnected spots; there is nearly always a subtriangular spot at the end of the caudal peduncle. The dorsal, caudal, anal, and ventral fins begin to develop the salmon or reddish tinge at about 30–40 mm. in length, and the red patch in the axil of the pectoral fin also begins at the same stage. These red patches develop before sexual maturity, and in both sexes; they are retained throughout the year, but may become more brilliant during the breeding periods.

As regards synonymy there is the initial difficulty in that we do not know what fish Andrew Smith actually described, as he did not give a definite locality, and his type is not extant. It may have been either *burchelli* (as we now know it) or *vulneratus* of Castelnau. Smith's description says "base [of dorsal fin] anteriorly directly over base of pectoral [*sic*, =ventral] fins"; the figure shows the ventral spine actually in advance of the origin of the dorsal fin. Smith's "*burchelli*" *might* be a *vulneratus*, though the ventral fin is figured as too far forward for this species. To avoid upsetting the nomenclature, Smith's discrepancies may be overlooked; and it will be assumed that his specimens came from a locality where *burchelli* (as now diagnosed) is known to occur.

Reasons for including part of Weber's *anoplus* material (juv.) and Boulenger's *burgi* (♂) have already been given.

At my request Mr. Norman examined the specimen (about 73 mm. in length) collected by H.M.S. *Challenger* "near Cape Town," which Boulenger identified and figured as *afer* Peters. It has *two* pairs of barbels, the anterior one at least $\frac{1}{5}$ the eye-diameter according to Mr. Norman; and Dr. Trewavas later informed me that the specimen agrees with the types of *burgi*.*

I have seen the specimen from Deelfontein, identified by Boulenger as this species; actually it is a specimen of *anoplus*. I have also

* While in Cape Town the staff of the *Challenger* made several excursions, but no details are given (Challenger Rep. Narrative, vol. i, pt. 1, p. 282). Without doubt they visited Stellenbosch and Paarl, where *burchelli* is common; and a specimen of the freshwater crab *Potamonautes perlatus* is recorded from the river at Wellington (Miers, Challenger Rep., xviii, 1886).

seen Weber's Oudtshoorn and Laingsburg specimens and find that they are really *asper*. Pellegrin's record of *burgi* from Angola will, I believe, prove to be another species, and probably not one with red-fins.

The two specimens from Robertson recorded by Gilchrist and Thompson are *vulneratus*.

The record of *Barbus? burchelli* in the Klein River, Stanford (Fish. Mar. Biol. Surv., Investigat. Rep., 7, p. 94, 1936) was based on casual observation of specimens in the water. Specimens netted on a later occasion proved to be juvenile *Mugil* and *Gilchristella*.

Barbus burchelli.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
9	4	$2\frac{1}{2}$	e > s	e > i	No scales					
10	$3\frac{3}{4}$	$2\frac{3}{4}$	,,	,,		,,		..	..	Dorsal and anal forming.
11	$3\frac{1}{2}$	3	,,	1		,,		2+5	None	Dorsal and anal rays distinct. Ventrals forming.
13	$3\frac{1}{2}$	3	,,	1		,,		..	..	Ventrals free.
15	$3\frac{1}{2}$	3	,,	1		,,				
18	$3\frac{1}{2}$	3	,,	1	28	12	..	..	(p)	
20	$3\frac{1}{2}$	3	,,	1	28	12	3	2+5	(p)	
25	$3\frac{1}{2}$	3	,,	$1\frac{1}{5}$	29	12	..	,,	p	
30	$3\frac{1}{2}$	3	,,	$1\frac{1}{5}$	28	12	4	,,	p	Red patches begin.
35	$3\frac{2}{3}$	$3\frac{1}{3}$	,,	$1\frac{1}{3}$	29	12	..	,,	p	
40	$3\frac{3}{4}$	$3\frac{1}{3}$	,,	$1\frac{1}{4}$	29	12	4–5	3+5	p	
45	$3\frac{3}{4}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	29–30	12	..	,,	p	
50	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$		12	5	,,	p	
55	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$	30–33	12	6–7	,,	p (a)	
60	$3\frac{4}{5}$	$3\frac{1}{2}$	1	$1\frac{1}{2}$		12	7–8	,,	p a	♂ with warts, ♀ ova.
70	$3\frac{3}{4}$	4	$1\frac{1}{4}$	$1\frac{1}{2}$		12	8	3+5–6	p a	
75	$3\frac{4}{5}$	$4\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{2}$	32–35	12	..	,,		
80	$3\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{2}{3}$		12	10	4+6		
85	$3\frac{3}{4}$	5	$1\frac{1}{2}$	$1\frac{2}{3}$		12				
90	$3\frac{3}{4}$	5	$1\frac{1}{2}$	$1\frac{2}{3}$		12	12	4+6		
95	$3\frac{4}{5}$	5	$1\frac{2}{3}$	2	34–36	12				
100	$3\frac{4}{5}$	$5\frac{1}{4}$	$1\frac{2}{3}$	2		12	14			
117	$3\frac{3}{4}$	$5\frac{1}{2}$	2	$2\frac{1}{4}$		12	16	4+6	..	♀ ova.

Barbus vulneratus (Cast.)

Castelnau's Red-fin; Rooivlerk.

Fig. 18, *b*, *c*.

1861. Castelnau, Mem. Poiss. Afr. Austr., p. 57 (*Gnathendalia vulnerata*).

1870. Steindachner, Sb. Ak. Wiss. Wien, lxi, p. 633, pl. 3, fig. 2 (*B. multimaculatus*).

1911. Boulenger, *l.c.*, p. 148, fig. 125 (part: the specimens from Zonder Eende River).

1913. Gilchrist and Thompson, *l.c.*, p. 416, fig. 73 (but not any of the recorded specimens).

1913. *Id.*, *ibid.*, p. 418 (*burchelli*, part: the 2 specimens from Robertson).

1937. J. L. B. Smith, *l.c.*, p. 127, pl. 31, fig. 2.

1938. Barnard, *l.c.*, p. 83.

[Probably not Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, 1934, p. 428; and *ibid.*, lxxxvii, 1935, p. 371. Natal.]

Castelnau placed this smallish species in a new genus named after the Moravian Mission, Genadendal. His description was inadequate for purposes of distinguishing the species from *burchelli*. Boulenger incorporated Steindachner's species, and separated *vulneratus* from *burchelli* by the slightly more forward origin of the ventral fins.

On a recent visit to the type locality a complete series of all stages was collected, which shows that the species is valid, although some individuals are sometimes difficult to distinguish from *burchelli*.

In specimens of *vulneratus* over 55 mm. in length: the ventral fins arise at the vertical from the 1st (apparent) dorsal spine or slightly in advance thereof; the interpolation of 2 more rows of scales (dorsally) on the caudal peduncle, making 14 in all (there are occasionally even 16), continues at least to the middle section, often along the whole, of the caudal peduncle; so that the scale count is normally 14 in contrast to the normal 12 in *burchelli*; the anterior pair of barbels is always better developed than in *burchelli*; there is also sometimes a tendency to the suppression of the tubule on some of the lateral line scales on the caudal peduncle. Predorsal scales 17–18.

The real validity of the species, however, is shown by the early development of the anterior pair of barbels, at the 21-mm. stage, as opposed to the delayed appearance of them (52–53 mm.) in *burchelli*.

As in *burchelli*, there are actually 4 dorsal spines, but the true 1st spine is very small and becomes obscured in half-grown and adult examples.

The scaling begins at 20–21 mm. At first there are only 12 scales around the caudal peduncle, but at about 30–35 mm. an additional row appears on either side dorsally, and from about 40 mm. upwards the normal number is 14.

The posterior pair of barbels appears at about 19 mm., and the

anterior pair very soon afterwards at about 21 mm. The anterior barbel becomes well developed, and in adults is usually as long as the eye-diameter.

The pectoral fin shows the same sexual difference as in *burchelli*. Large warts on head in ♂, as in *burchelli*.

Judging by the Genadendal series, *vulneratus* arrives at sexual maturity at a smaller size than does *burchelli*: ♂♂ with conical tubercles on the head at 50–55 mm., and ♀♀ with ripe ova at 55–60 mm. Castelnau said the species grew to a length of 120 mm., but the largest caught on the recent visit were 90 mm. in length.

The coloration is the same as in *burchelli*, but the spots in the young and half-grown, and even the adults, appear to be more conspicuous. The red colour on the fins and in axil of pectoral is very brilliant.

Details at different stages are as follows: up to 15 mm. heavily and more or less uniformly pigmented, dorsal fin pigmented along its base and in the angle of the 3rd spine; at 18–20 mm. body paler and becoming silvery on opercles and belly, pigment aggregated more or less into ill-defined spots along the side, with a more definite spot at end of caudal peduncle, angle at base of 3rd dorsal spine and the spine itself dark; at 30 mm. spots along sides and on back, spot on caudal peduncle distinct, base of dorsal fin dark, a faint tinge of salmon at base of dorsal and caudal fins; at 45 mm. brownish, more or less silvery on belly, the dark spots subcircular, or vertically or horizontally oval, more or less united into a longitudinal stripe, spot on caudal peduncle subtriangular and always distinct, all fins (except pectoral) and the spot in axil of pectoral more or less reddish; from 55 mm. upwards the red patches get their full blood-red colour, the pectoral fin remains greyish, with only a faint pink tinge in its basal half in some large specimens.

The status of Steindachner's *multimaculatus* is doubtful, and is likely to remain so unless the precise locality of his specimens were discoverable and a series obtained from that locality.

Boulenger assigned to *vulneratus* some specimens from "Zonder Eende River (tributary of Forcade River) near Ondtsloon" [*sic*].* Boulenger repeatedly misspells Oudtshoorn, but I am unable to trace on any map, or by local enquiries, a "Forcade" River in that neigh-

* In a letter (9.xii.09) to Gilchrist he asked for the exact position of "Porcade (?) R." and "Ondtsloon." Apparently Gilchrist never enlightened him. Gilchrist's handwritten labels could be easily misread by anyone not knowing the localities.

bourhood; in any case the Zonder End River, though correct for Castelnau's type locality, is nowhere near Oudtshoorn.

Baakens River, near Port Elizabeth, is another locality recorded by Boulenger which must be deleted, because the 3 specimens, which were recorded by Gilchrist and Thompson from this locality and which bear the identification label "*vulneratus*" in Boulenger's handwriting, have only a single pair of barbels and are referable to *senticeps* (*v. infra*).

Of Gilchrist and Thompson's other material, the Yokeskei River specimens are probably *motebensis*; the smaller of the two specimens from Zwartkops River is *pallidus* and the larger one *senticeps*!

Even if Gilchrist and Thompson's material had not been available, the Baakens and Zwartkops localities would have been open to doubt, as the species is absent from the intervening Gouritz River system. And on a recent collecting trip to the Zwartkops River no specimens of *vulneratus* were obtained.

Besides the Genadendal series, other specimens are at hand from the headwaters of the River Zonder End on the east side of French Hoek Pass (near Villiersdorp) (K. H. B. and C. W. T., Oct. 1936); Slanghoek and Witte rivers (tributaries of the Breede River); Michell's Pass River (H. G. Wood, 1938); Hex River at Sandhills, near

Barbus vulneratus.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
10–11	4	2½	e > s	e > i	N	o scale	s	..	None	
12–13	3⅘	2¾	,,	,,		,,		..	,,	Dorsal forming.
14	3¾	3	,,	,,		,,		..	,,	Anal forming.
15	3½	3	,,	1		,,		0+4	,,	Dorsal and anal rays distinct; ventral fins just free.
17–18	3⅓	3	1	1		,,		0+5–6	,,	
20	3¼	3	1	1	Not	distinct		1+5	(p)	
22–23	3⅓	3	1	1	34	12	3	2+5	p (a)	
25	3⅓–3½	3	1	1	34	12	..	..	p a	
30	3½	3	1	1	33	12–14	4	2+6	p a	
35	3⅔	3–3⅙	1	1⅙	33	12–14	..	..	..	Red patches begin.
40	3⅔	3¼	1	1⅕	33	14	5–6			
45	3⅔	3⅓	1	1¼	34	14				
50	3⅔	3½	1	1⅓	34	14	8	2+6	..	♂ with warts.
55	3½–3⅔	4	1⅓	1½	34–36	14	..	..	..	♂ with warts. ♀ ova.
60	3½	4¼	1½	1½	35	14	..	2+6	..	♂♀.
70	3½–3⅔	4½	1½	1½	35	14	..	..	..	♂♀.
80	3½–3⅔	4¾	1½	1⅔	34	14	10	3+6–7	..	♂♀.
90	3⅔	5	2	2	36	14	..	..	..	♂♀.

Worcester (A. C. Harrison); Cogman's Kloof River at Montagu (tributary of the Breede River) (H. G. Wood, 1938); Buffelsjagt River (tributary of the Breede River); the Robertson (Breede River) specimens recorded by Gilchrist and Thompson; long series from the Nieuwejaar, Grashoek, and Kars rivers in the Elim-Bredasdorp area (K. H. B. and C. W. T., 1937); Duivenhoks River, Heidelberg (Cape) and Vette and Kaffirkuils rivers, Riversdale (A. C. H., K. H. B., and C. W. T., 1938) (figs. 1 and 6).

The occurrences in the Nieuwejaar, Grashoek, Kars, Duivenhoks, and Kaffirkuils rivers are interesting as indicating the former connection of these, now independent, rivers with the extended Breede River across the Agulhas Bank (fig. 1, area 7, 7*a*, 7*b*).

Barbus pallidus A. Smith

Goldie.

1841. A. Smith, Illustr. Zool. S. Afr. Fish., pl. xi, fig. 2.

1911. Boulenger, *l.c.*, p. 149 (species *dubia*).

1911. *Id.*, *ibid.*, p. 150, fig. 126 (*hemipleurogramma*).

1913. Gilchrist and Thompson, *l.c.*, p. 426, fig. 85 (*hemipleurogramma* (part: the specimens from Baakens River, not the Transvaal specimens).

1913. *Id.*, *ibid.*, p. 416 (*vulneratus* non Cast., part: the smaller specimen from Zwartkops River).

1916. Boulenger, *l.c.*, p. 272 (*anoplus* non Weber).

1937. J. L. B. Smith, *l.c.*, p. 127, pl. 29, fig. 4 (*hemipleurogramma*).

1938. Barnard, *l.c.*, p. 83.

Sir Andrew Smith not only travelled widely in the Cape, but set out on one of his most important expeditions from Port Elizabeth (see *supra*, p. 116). It is reasonable to assume that he obtained samples of the fishes from the rivers in that neighbourhood, where to-day the species described by Boulenger as *hemipleurogramma* is common.

Smith's figure shows the following essential features: 2 barbels on each side, l.l. scales 31 or 32, caudal peduncle 12, pre-dorsal 12 or 13, l.tr. $\frac{4\frac{1}{2}}{4\frac{1}{2}}$, and 3 between l.l. and ventral. If allowance be made for the artist's propensity for indicating too many scales (see *supra*, p. 115)—and the fewer the scales the less likelihood of exceeding the correct number—all these features are characteristic of *hemipleurogramma*. Yet Boulenger in a note on *pallidus* on the page preceding

the description of his *n. sp.* failed to recognize the resemblance, or was too cautious to resuscitate *pallidus* in the absence of Smith's type specimen.

There cannot be, I think, the slightest doubt that Smith and Boulenger refer to one and the same species. It is the only species in the western Cape Province with 2 pairs of barbels and non-serrate dorsal spine, combined with so few and such large, radiately striate, scales. Smith himself remarked on the large size of the scales.

The coloration of the living fish, well described by Smith, fades on preservation to that given by Boulenger. A somewhat more detailed note of the coloration was taken (K. H. B.) at the time of capture of specimens in the Zwartkops and other rivers: silvery, brownish above, more or less golden, especially in adult ♂♂, more greyish in ♀♀; a line of black spots along sides; one at base of caudal and one at base of anal fin present in the youngest stages upwards; when the brilliant golden colour in ♂ is fully developed the lateral spots are not apparent; a golden tinge on opercle behind eye; fins pale; caudal more or less yellowish, and in golden specimens (♂♂, and often also in ♀♀) the middle caudal rays are deep orange or even reddish.

Although Smith described the lateral line as extending to the base of the caudal fin, this is not necessarily an objection to the suggested synonymy. The incompleteness of the lateral line, regarded as one of the specific characters of *hemipleurogramma*, is not at all constant. Though not frequent, there are specimens in which the lateral line is complete at least on one side; and there are many in which the line is interrupted at two or more places; that is, the line ceases at the anterior third or half of the body and is indicated by two or more single tubules, or groups of tubules, and ending with one or two tubules at the base of the tail. Incompleteness of the lateral line is, however, the normal condition; but where a tendency to suppression of the tubules occurs, the utmost inconstancy and variability may be expected (*cf.* also *vulneratus* and *asper*).*

This species has a very neat appearance due to the regularity of the large scales; this regularity is particularly noticeable along the dorsal profile, where there are normally 10 (10–11) predorsal scales, in contrast with the frequently irregular arrangement in species having a larger number of predorsal scales.

It is a small species attaining sexual maturity at about 38–40 mm. The largest specimens examined are females.

There are no red patches at the bases of the fins, and no warts

* *Cf.* Hora, Misra and Malik, 1939, Rec. Ind. Mus., xli, pp. 268, 269.

on the head in the ♂. The pectoral fin in juveniles and ♂♂ reaches to or almost to the base of the ventral fin spine, but in ♀♀ is separated by a gap about half the length of the pectoral fin.

At 15 mm. the posterior barbel is just beginning, and the anterior one appears at about 17–18 mm. Scaling begins at 15 mm.

The young, once they have attained their scales, are thereby distinguished from the young of *senticeps*, with which species they are often associated, as well as by the black spot at base of anal and caudal fins. But the very young stages I have not yet been able to discriminate with certainty. Breeding in aquaria would settle this point.

In the anal fin only 2 spines are observable in the adult, but in the young 3, sometimes 4 or even 5, can be counted.

In addition to Gilchrist and Thompson's material (Baakens and Zwartkops rivers) I have collected and examined series from the Zwartkops River at Uitenhage (Groendal valley); Van Staden's River; Baviaans Kloof, and smaller tributaries of the Gamtoos River at Loerie and Patentie; Zeekoe River near Humansdorp; Kromme River at Assegai Bush. Also I have seen a single specimen from Howieson's Poort, Grahamstown (Kariega River), which appears to be conspecific; I should prefer to see living and fresh material before finally accepting this locality (figs. 6 and 7).

Boulenger's 1916 specimens of "*anoplus*" are referred to the present species on the authority of Dr. Trewavas.

Not having seen any fresh material, I express no opinion on the specimens from the Transvaal recorded by Gilchrist and Thompson.

Abnormalities.—The following abnormalities have been noticed and should be borne in mind in discussing the possibility of "n. spp." having been based on such casual variants. Approximately 6·2 per cent. of the specimens have 8 dorsal rays instead of the normal number of 7.

Out of 19 specimens from Baakens River, one juv. with 8 branched dorsal rays.

Out of 7 specimens from Zwartkops River, Uitenhage (C. L. Biden, 1935), one ♀ with 8 dorsal rays, one ♂ with 6 dorsal rays and in addition l.l. 32 (right), 31 (left), caudal peduncle 12, predorsal 13, and *only the posterior pair of barbels*. This latter specimen, on paper, might have been thought to be a *senticeps*, but the specimen was seen by me in a fresh state, had no red-fins, and was obviously *pallidus*. Out of 150 specimens from same locality (K. H. B. and C. W. T., 1938), 3 (1 ♂, 2 ♀♀) with 8 dorsal rays; 2 ♀♀ with 6 dorsal

rays. Out of 4 specimens from Van Staden's River, one ♀ with 8 dorsal rays. Out of 7 specimens from Zeekoe River, Humansdorp, 2 ♀♀ with 8 dorsal rays. Out of 25 specimens from Loerie, 4 ♂♂ with 8 dorsal rays, 1 juv. with 9 dorsal rays, one ♀ with 7 rays, the 4th and 5th intertwined. Out of 6 specimens from Assegai Bush, 1 juv. with 5 dorsal rays. Out of 135 specimens from Baviaans Kloof, 2 ♂♂, 4 ♀♀, 3 juv. with 8 dorsal rays, 1 ♀ with 6 anal rays, 1 ♀ with 8 dorsal and 6 anal rays, 1 ♀ with 7 dorsal rays, the 4th and 5th intertwined.

There is a distinct resemblance (accepting current diagnoses) between specimens with 8 dorsal rays and *B. lineomaculatus*, and even more so with *B. viviparus*, in view of the black spot at base of anal fin.

Parasites.—When slitting the bellies of specimens in the field it was noticed that some specimens contained large globular bodies which appeared as if they might be large ova indicating viviparity. The case of *B. viviparus* recurred to mind, especially as the specimens were superficially very like *viviparus*.

Closer examination, however, at once showed that these bodies were parasitic Trematodes. They were encysted in the gonads, and

Barbus pallidus.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Baakens R., P. Eliz.	15	3¼	3	e > s	1	26	12	4	1+4	(p)	Fin rays distinct. Black spot at base of anal and caudal.
	18	3¼	3	,,	1	27	12	..	2+4	p (a)	
	20	3⅓	3	,,	1	28	12	4–5	..	p a	
	25	3½	3	,,	1	27	12				
	30	3¾	3	,,	1	28	12	5–6			
Zwartkops R., Uitenhage.	35	3¾	3¼	,, or =	1¼	27–29	12				
	40	3¾	3⅓	·1	1¼	27–29	12	,,	,,	..	♀ ovig.
	42	3¾	3⅓	1	1⅓	27–29	12	,,	,,	..	♀ ovig.
	45	3⅘	3½	1	1⅓	27–30	12	6	2+4–5		
	50	4	3½	1	1½	27–30	12	..	..	..	♂ ovig. ♀.
	52	4	3½	1	1½	27–30	12	6–7	..	..	♂.
	55	4	3½	1	1½	27–30	12	..	..	..	♀ ovig.
	57	4	3⅔	1	1½	27–30	12	7–8	..	..	♀ ovig.
Zwartkops	60	4	3¾	1	1½	28	12	8	2+4–5	..	♀ ovig.*
Howieson's Poort	47	4	3⅔	1	1½	29	12	6	2+4	..	♀ ova.

* Gilchrist and Thompson's 52-mm. (measured to end of scaling) specimen recorded by them as "vulneratus."

occurred in both sexes, but more frequently in ♀♀ than ♂♂. In some cases nearly the whole space normally occupied by the ova was filled with 4–6 of the parasites, leaving scarcely any space for the ova. When removed from the cyst, the flukes were oval-shaped, narrowing in front, 7–8 mm. in length and 5 mm. in width.

Dr. Baylis of the British Museum very kindly identified these Trematodes as the metacercariae of *Euclinostomum* sp., probably *E. heterostomum* (Rud., 1809), the adult of which is a parasite of herons.

Barbus asper Blgr.

Plump Red-fin, Rooivlerk.

Fig. 19, *a*.

1897. Weber, *l.c.*, p. 153 (*burchellii* non A. Smith, from Buffles River, Laingsburg, and Kammenassie River, Oudtshoorn).

1911. Boulenger, *l.c.*, p. 176, fig. 154.

1911. *Id.*, *ibid.*, p. 177 (*anoplus* non Weber, part: nos. 1–10, Grobelaars River, Oudtshoorn).

1913. Gilchrist and Thompson, *l.c.*, p. 427, fig. 86, and p. 579.

1913. *Id.*, *ibid.*, p. 428 (*anoplus* non Weber, part: only the 12 specimens from Grobelaars River, Oudtshoorn).

1917. Boulenger, C.R. Ac. Sci. Paris, clxiv, p. 299 ("*spinosus*," laps. cal.).

1938. Barnard, *l.c.*, p. 84.

[Probably not *asper* Borodin, Zool. Jahrb. Abt. Syst., lxviii, 1936, p. 6. Lake Tanganyika! *]

The editorial statement on p. 579 of Gilchrist and Thompson's monograph is true in so far as the said specimens are adults of the species which was at that time thought to be *anoplus*, but which is in fact *asper*; the suggestion that *asper* was a synonym of *anoplus* has been shown to be wrong.

This species has no anterior barbels at any stage of growth. The posterior barbels develop at about 28 mm. Juveniles from this size up to 50 mm. are distinguished from *burchelli*, which at this size has only the posterior barbels, by the larger number of predorsal and caudal peduncle scales. Scaling begins at about 23 mm.

The red patches at the bases of the fins begin to show at about 30 mm. in both sexes. Warts on the head in males. The pectoral

* Myers (1936, Proc. U.S. Nat. Mus., lxxxiv, p. 11, footnote) declines to accept this author's identifications. As regards "asper," I most emphatically agree with Dr. Myers.

fin reaches to or almost to the base of the ventral fin in juveniles and males, but is relatively shorter in females.

Spawning takes place between September and February. Sexual maturity is reached at about 60 mm.; and the greatest length hitherto recorded is 110 mm., but recently one of 118 mm. was caught in the Kabeljouw River (see *infra*).

Originally described from the Groote River * (Gamtoos system) at Steytlerville, and Le Roux River near Oudtshoorn (Gouritz system). I have collected long series in both of the type localities; and have obtained specimens from the following localities:—

(*a*) Gouritz system—Buffels River, Laingsburg, and its lower course (Groote River) † near Ladismith; Gamka Poort and Meiring's Poort in the Zwartberg Range; Rossel River, near Klaarstroom; Le Roux River at Schoemann's Poort, near Oudtshoorn; Doorn River, north of Montagu Pass (tributary of the Kamanassie-Olifants); Touws River between Ladismith and Montagu (village) ‡; Langtouw River, near Herbertsdale; Weiders and Valsch rivers in the Albertinia district. Also at Haalkraal on upper reaches of the Little Brak River, an independent river entering the sea in Mossel Bay.

(*b*) Gamtoos system—Baviaans Kloof River; Couga River at Haarlem; tributary of the Gamtoos River at Patentie. Also the independent rivers: Kabeljouw, Rondebosch, and Zeekoe in the Humansdorp district.

(*c*) Keurbooms River, near Paardekop, and at Edmonton; a tributary of the Kruis River, near Knysna; the Homteni River (= upper part of the Goukama River); and Ruigte Vlei ‡ (figs. 6 and 7).

Dr. Trewavas of the British Museum has kindly examined the specimens nos. 1–10 from the Grobelaars River, Oudtshoorn, which Boulenger recorded as "*anoplus*" and finds that the scales around the caudal peduncle number 16 to (in the largest specimens) 20. I have seen samples of the scales from these specimens, and they agree with my own material, and also a scale from the type specimen of *asper* from Steytlerville. Dr. Trewavas also finds that the specimens nos. 17, 19, and 20 have respectively 14 or 15, 14, and 16 scales around the caudal peduncle. These might also be *asper*, and if they are, the Port Elizabeth area must be included in the distribution of the species. I prefer, however, to withhold my opinion on this for

* See *supra*, p. 119, on duplication of place-names.

† See p. 119, duplication of place names.

‡ Opposite Post Office, Ruigte Vlei. The railway siding of the same name is opposite Groen Vlei.

the present, because in the course of my own collecting in the Zwartkops River, and other neighbouring rivers, no specimens of *asper* were obtained. I have not, however, examined as yet the Baakens River at Port Elizabeth.

I have seen Max Weber's specimens from the Buffels and Kamanassie rivers, which he called "burchellii." It seems that Weber overlooked the absence of the anterior barbels, or else laid more stress on the presence of the red-fins corresponding with Andrew Smith's

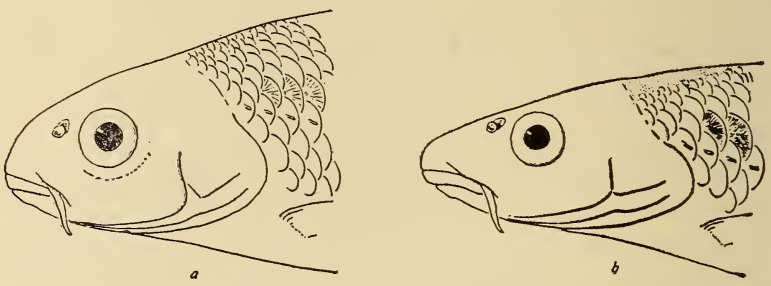


FIG. 19.—*Barbus asper: a.* Head of ♀ (semidiagrammatic). *Barbus tenuis: b.* Head (semidiagrammatic; dotted portion represents bare post-occipital area). De Rust, near Oudtshoorn.

coloured figure. His statement that the pectorals do not reach the origin of the ventral fin is true of the ♀, but apparently he did not examine the ♂♂ in his collection.

For comparison with the next two species (*senticeps* and *tenuis*) the chief diagnostic features may be given: mature ♂♂ with warts on head; mouth terminal; depth of body subequal to or greater than length of head; scales with few (8–12) striae, l.l. 36–42, l.tr. 7–8 between dorsal spine and l.l., 5–6 between latter and ventral spine (the lateral line tubuliferous scale not counted); 16–18 or 20 around caudal peduncle, 19–25 predorsal, commencing immediately behind occiput, without any bare patch; base of ventral below anterior dorsal rays; the l.l. series of tubules may be complete, but more often (75 per cent.) is incomplete or irregularly interrupted.

Silvery, greyish or brownish above, innumerable tiny dark dots tending to form a dark spot in centre of each scale, giving a speckled appearance; bright red patches at bases of dorsal, anal, and ventral, and in axil of pectoral fins. After preservation a more or less (usually less) conspicuous dark lateral stripe.

The above diagnosis, in regard to the number of predorsal and

caudal peduncle scales, applies to what may be called the typical form, found at Steytlerville and throughout the Gouritz River system.

Barbus asper.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Gouritz River system.	7–8	4½	2½	e > s	e > i	N	o scales	s	..	None	
	10	4	2¾	,,	,,		,,		..	,,	Dorsal and anal fins beginning.
	12–13	4	3	,,	,,		,,		..	,,	Dorsal and anal rays distinct.
	14	4	3	,,	,,		,,		..	,,	Ventral fins showing.
	15	4	3	,,	,,		,,		..	,,	Ventral fins free.
	17	4	3	,,	,,		,,		..	,,	
	20	3¾	3	,,	l		,,		..	,,	
	25	3½	3¼	,,	l	30–32	14	4	1+4	,,	
	30	3½	3⅓	,,	1¼	34	14–16	4–5	2+5	(p)	Red patches begin.
	35	3½	3½	l	1½	34–38	16	6	..	p	
	40	3½	3½	l	1½		16–18	..	3+6		
	45	3⅔	3¾	l	1½			8			
	50	3¾	4	1⅕	1½			..	3+7–8		
	55	3⅘–4	4	1¼	1½			10			
	60	4	4–4¼	1⅓	1⅔			..	..	..	♂ with warts, ♀ ova.
	65	4	4½	1½	1¾			..	..	..	♂♀ The L/H figure
	70	4	4½	1½	1¾	36–42	18	12	..	..	,, is often a little
	75	4	4½	1½	1⅘		18	..	3–4+8	..	,, less than that
	80	4	4¾	1⅔	1⅘		18	..	..	..	,, here given in
	85	4	5	1¾	2			..	4+9	..	,, the case of
	90	4	5	1¾	2			..	..	..	,, ♂♂, *i.e.* the
	95	3⅘	5	1⅔–1¾	2		18–20	..	..	..	,, head is relatively slightly
	100	3⅕	5	1⅔–1¾	2			12 (–14)	4+9–10	..	,, larger in ♂♂
	105	3⅘	5	1¾	2			..	..	..	,, than in ♀♀.
Kabeljouw R.	118	3⅘	5¼	1¾	2	37	16	..	..	..	♀ ovig. Record size.
Ruigte Vlei.	45	3¾	3½	l	1⅓	36–38	16	7–8	2+8	p	
	50	3¾	3¾	l	1½			..	..	..	♂.
	55	3¾	3⅘	1⅕	1½			..	..	..	♂.
	60	3¾	3⅘	1⅕	1½			..	..	..	♀ ovig.
	65	3¾	3⅘	1¼	1½–1⅔			8–9	..	..	♂ with warts.
	70	3¾	4	1¼	1¾			..	..	..	♂ ,, ,,
	75	3¾	4⅕	1¼	1¾			..	..	..	♂ ,, ,,
	80	3¾	4¼	1⅓	1¾			..	..	..	♂♀ ovig.
	83	3⅘	4⅓	1⅓	1¾			10–11	..	..	♀ ovig.

In the localities given above under (*b*) and (*c*), certain local varieties occur (see fig. 7). *E.g.* in the Kabeljouw River a large number of adults was obtained, including one of record size (118 mm.). None of these had more than 16 scales around the caudal peduncle, and the number of predorsal scales varied from 17–20. As a result of this

latter feature the rather crowded appearance of the scales on the upper part of the shoulder, so characteristic of the typical form, was lacking.

The Ruigte Vlei series agrees with those from the Kabeljouw River and other localities as regards the predorsal and caudal peduncle scaling. But when alive they had a beautiful warm brown or golden-brown appearance, in marked contrast to the usual silvery-grey colour of the typical form. This colour was noticeable, but to a lesser degree, in the Homteni River specimens. In both these localities the water is of rather high acidity (pH 4–4·5), whereas the more silvery-grey forms come from water which is alkaline (pH 8–9). The acid waters are brown in colour; and the alkaline ones are frequently opaque with a considerable amount of mud in suspension. Compare a similar correlation between the colour of the fish and the clarity or opacity of the water in *Sandelia* (p. 248).

Barbus senticeps J. L. B. Smith

Uitenhage Red-fin, Rooivlerk.

1911. Boulenger, *l.c.*, p. 177, fig. 155 (*anoplus*, part, non Weber: no. 18, Port Elizabeth, the specimen figured, assuming figure is natural size).

1913. Gilchrist and Thompson, *l.c.*, p. 416 (*vulneratus* part, non Cast.: 3 specimens from Baakens River, and the larger of the 2 from Zwartkops River).

1913. *Id.*, *ibid.*, fig. 87, after Boulenger (*anoplus* non Weber. Not the description, nor the recorded specimens).

1936. J. L. B. Smith, Trans. Roy. Soc. S. Afr., xxiv, p. 54, fig. 3.

1937. *Id.*, *l.c.*, p. 124, fig. 2.

1938. Barnard, *l.c.*, p. 84.

Dr. Trewavas has kindly examined Boulenger's specimens nos. 11–20 of "*anoplus*," and informs me that nos. 11–17 have 12–14 or 15, and nos. 19 and 20 respectively 14 and 16, scales around the caudal peduncle; and that no. 18, with 13 scales around caudal peduncle, appears to be the specimen figured by Boulenger, assuming the figure to be natural size. No. 11 is clearly a *senticeps*, and probably also nos. 12 and 13 (13 scales c.ped.); but whether nos. 14, 15, 16, and 19 (14–15 scales) can be included is doubtful. Confirmation must be sought by further collecting in the Port Elizabeth area to see if *asper* occurs along with *senticeps*. Specimen no. 20 (16 scales) would certainly seem to be *asper*.

This species agrees with *asper* in having only one pair of barbels, but is distinguished by having normally only 12 scales around caudal peduncle. The posterior barbel is already showing in a specimen of 23 mm., the smallest specimen of this species yet obtained. The red-fins begin at about 30 mm. Pectoral shorter in ♀ than in ♂.

Barbus senticeps.

	TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Zwartkops R., Uitenhage. Kromme R., Assegai Bush.	23	3¼	2½	e > s	e > i	30	12	4–5	1+6	(p)	
	25	3⅓	2½	,,	,,	30	12	4–5	1+6	p (⅙ eye)	
	30	3⅓	2¾	,,	,,	30–32		..	..		Red patches begin.
	35	3⅓	3	,,	1			6	2+6		
	40	3½	3	,,	1						
	45	3½	3⅓	1	1¼			..	..	..	♂ immat. ♀ ovig.
	50	3½	3½	1	1¼			8	..	..	♂, ovig. ♀.
	55	3½	3⅝	1	1⅓						,,
	60	3⅔	3⅔	1	1⅓			..	..	..	♂ with warts, ovig. ♀.
	65	3⅔	3¾	1	1⅓		12	..	..	..	,,
	70	3¾	4	1+	1½			..	2 or 3+ 6 or 7	..	,,
	75	3¾	4	1⅕	1½	30–34		10	..	..	,,
	80	3⅘	4	1¼	1½			..	2+8	..	,,
	85	3¾	4	1⅓	1⅔			12	..	..	♂ Head slightly larger in ♂ than in ♀ (cf. *asper*).
	85	4	4	1¼	1½			..	..	..	♀
	90	4	4	1¼	1½			..	..	..	♀.
	95	4	4¼	1¼	1⅔			12	3+8	..	♀.

For comparison with *asper* and *tenuis* the following characters are given: mature ♂♂ with warts on head; mouth subterminal; depth of body subequal to length of head; scales with few (8–12) striae, l.l. 30–34, l.tr. 5–6 between dorsal spine and l.l., 4–5 between latter and ventral spine, 12 around caudal peduncle, 14–16 predorsal; lateral line tubules more or less incomplete.

This species was described by J. L. B. Smith from a single ♂ specimen from the Kromme River, Assegai Bush, Humansdorp Division, with only 10 scales around the caudal peduncle.

The South African Museum has a ♀ from the same locality (F. G. Chaplin, 1935); 2 ♂♂ from the Zwartkops River, north of Uitenhage (C. L. Biden, 1935); 1 ♀ from Zwartkops River recorded by Gilchrist and Thompson as *vulneratus*; and 3 specimens from the Baakens River. The latter three were identified by Boulenger (label in his handwriting accompanies the specimens) as *vulneratus* in spite of

their having only one pair of barbels, and were recorded by Gilchrist and Thompson as *vulneratus*.

I have collected a good series in the type locality at Assegai Bush, and in the Geelhoutboom River, a tributary of the Kromme River; and also in the Zwartkops River above Uitenhage, and its tributary the Brak River. Contrary to the expectation expressed in my 1938 paper (p. 84), *senticeps* has not yet been found in the Gamtoos system.

So far as at present known, therefore, this species is confined to two of the smaller river-systems, separated by the lower reaches of the large Gamtoos River (fig. 7). In former times the Kromme River was certainly a tributary of the Gamtoos, and apparently the Zwartkops was also. But it is difficult to explain why *senticeps* and *asper* appear to be mutually exclusive in a river, while *pallidus* is found associated with the one or the other of these two species in all the rivers in the Uitenhage, Port Elizabeth, Humansdorp area.

The fauna of the Baakens River, Port Elizabeth, has not been investigated in recent years.

Barbus tenuis Brnrd.

Slender Red-fin.

Fig. 19, *b*.

1913. Gilchrist and Thompson, *l.c.*, p. 428 (*anoplus* non Weber, part: the specimens from Le Roux River, Cango).

1938. Barnard, *l.c.*, p. 87.

Depth of body less than length of head, the former $4\frac{1}{2}$, the latter $3\frac{1}{3}$ (juv.), 4 (adult) in length of body (excluding caudal fin). Eye $2\frac{1}{2}$ (juv.), 5 (adult) in length of head, 1–2 in interorbital width, greater than snout to about 35 mm., after that 1–2 (or nearly 2) in snout. Snout rounded, projecting beyond mouth, which is definitely inferior. Lips thin, lower labial grooves interrupted medianly. A single (posterior) barbel on each side, developing at the 22-mm. stage, not exceeding eye-diameter in length. Gill-rakers 2 + 5 (6) to 3 + 7 (8) on anterior arch. No warts on head in ♂.

D iii. 7, the 3rd spine a little nearer to end of caudal peduncle than to tip of snout, shorter than depth of body, thin, flexible, non-serrated. There are really 4 spines, but the true 1st is obscured in half-grown and adults. A iii. 5. Pectoral extending to or nearly to base of ventral spine in juv. and ♂, but in ♀ extending only to about $\frac{2}{3}$ distance between bases of pectoral and ventral. Ventral fin in

advance of dorsal, the last ventral ray below the 1st–3rd dorsal spines.

Scales radiately striate, striae numerous, about 8 (juv.), 24 (adult); l.l. 32–36 (37), the series of tubules complete, rarely one or two missing posteriorly; l.tr. 5 between dorsal spine and l.l., 3 between latter and ventral spine; 12–14 around caudal peduncle, with occasionally in large specimens accessory scales; predorsal (12) 15–20, usually beginning, but irregularly and somewhat inconstantly, some little distance behind occiput, thus leaving a bare triangular patch, nearly always present but variable in extent.

Up to 85 mm. Silvery, rather heavily suffused with brown above, after preservation a dark lateral stripe expanding into a more or less defined spot on end of caudal peduncle; fins greyish, base of dorsal, anal, ventrals, and axil of pectoral brilliant red, beginning to develop at about the 30-mm. stage.

Localities.—Gouritz River system—Seven Weeks Poort, Amalienstein, near Ladismith; Meiring's Poort; Rossel River, near Klaarstroom; tributary of the Olifants River, near De Rust, Oudtshoorn; Grobelaars and Le Roux rivers, near Oudtshoorn; Moeras River, between Oudtshoorn and Robinson Pass; tributary of Kamanassie River (farm "Waterval"); Langtouw River, Herbertsdale (figs. 6 and 7).

Remarks.—Although the 4 largest of Boulenger's specimens nos. 1–10 of "*anoplus*" from Grobelaars River have 16–20 scales around caudal peduncle, as Dr. Trewavas informs me (p. 197), possibly some of the smaller ones from the same lot really belong to this species. Gilchrist and Thompson's Le Roux River material, recorded as "*anoplus*," belongs to this species.

In the field, when freshly caught it is easily distinguished from *asper* by its slender shape, and the more suffused brownish coloration; *asper* tends to be more silvery, with greyish speckling, like a "speckled hen." After preservation the dark lateral stripe, though often to be seen in *asper*, is always much more pronounced in *tenuis*.

For comparison with *asper* and *senticeps* the following characters are given: no warts on head in ♂♂; mouth inferior; depth of body less than length of head (even in gravid ♀♀ it is scarcely equal to head); scales with numerous (14–24) striae, l.l. 32–36, l.tr. 5 between dorsal spine and l.l., 3 between latter and ventral spine, 12–14 around caudal peduncle, (12) 15–20 predorsal, usually not beginning immediately behind occiput, but leaving a bare triangular space; base of ventral in advance of dorsal; lateral line tubules nearly always complete.

The scales, with their numerous striae, resemble those of *anoplus*; but in specimens which have lost all trace of distinctive coloration, the shape of the snout and the number of caudal peduncle scales are decisive differences.

The bare patch behind the occiput is very noticeable in the material from De Rust (fig. 19, *b*), but is not so constant in that from other localities; in nearly every specimen from the Langtouw River the scales start almost immediately behind the occiput. This feature therefore cannot be regarded as always decisive.

Barbus tenuis.

		TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
Grobelaars R.	Moeras R.	15	$3\frac{2}{3}$	$2\frac{1}{2}$	e < s	1	No scales			..	None	Fin rays distinct.
		17	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	1		,,		..	,,	
		20	$3\frac{1}{3}$	$2\frac{4}{5}$	,,	1		,,		1+4	,,	
		23	$3\frac{1}{3}$	$2\frac{4}{5}$–3	,,	1		,,		..	(p)	
		25	$3\frac{1}{3}$	3	,,	1	33	12	8	2+5	p	
		30	$3\frac{1}{2}$	3	,,	1	32	12	..	..	p	Red patches begin.
		35	$3\frac{1}{3}$	3	,,	1	33–34	12	10–12	2+5–6		
		40	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	33	12	..	..	..	Immature ♂♂ and ♀♀.
		45	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	32–35	12(–14)	12–14	..		♂♂ no warts. ♀♀ ovig.
		50	$3\frac{2}{3}$	$3\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{3}$				2+6–7		
		55	$3\frac{3}{4}$	4	$1\frac{1}{3}$	$1\frac{1}{3}$			16–18			
		60	$3\frac{3}{4}$	4	$1\frac{1}{3}$	$1\frac{1}{2}$						
		65	$3\frac{3}{4}$	$4\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{2}$			18–20			
		70	$3\frac{3}{4}$	$4\frac{1}{2}$	$1\frac{2}{3}$	$1\frac{2}{3}$				3+7–8		
		75	$3\frac{3}{4}$–$3\frac{4}{5}$	$4\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{3}{4}$	33–36		22–24			
		80	$3\frac{4}{5}$	5	$1\frac{4}{5}$	$1\frac{4}{5}$						
		85	4	5	$1\frac{4}{5}$–2	2			24	3+7–8		

Barbus phlegethon Brnrd.

Figs. 15, *d*, 20.

1938. Barnard, *l.c.*, p. 87.

Depth of body $3\frac{3}{4}$–4, length of head $3\frac{1}{2}$ (juv.), 4 (adult) in length of body (excluding caudal fin). Eye $2\frac{1}{2}$ (juv.), $3\frac{1}{2}$ (adult) in length of head, 1–$1\frac{1}{3}$ in interorbital width (greater than interorbital in very young), greater than snout up to about 37 mm., equal to snout in larger specimens. Snout moderately rounded, projecting slightly beyond mouth, which is subinferior or definitely inferior. Lips thin, lower labial grooves interrupted medianly. A single (posterior) barbel on each side, developing at about the 25-mm. stage, not exceeding $\frac{1}{2}$ eye-diameter. Gill-rakers 2+4–6 on anterior arch.

D iii. 7, the 3rd spine equidistant from tip of snout and last scales on caudal peduncle, not quite equal to length of head, thin, flexible, non-serrate. A iii. 5. Pectoral extending to about $\frac{2}{3}$ distance between bases of pectoral and ventral in ♀, $\frac{3}{4}$ or $\frac{4}{5}$ that distance in ♂. Ventral spine arising in vertical from 3rd dorsal spine. Caudal peduncle about $1\frac{2}{3}$ as long as deep.

Scales radiately striate, beginning at about the 15–16-mm. stage, striae few, about 4 or 5 (juv.) to 7 or 8 (adult); l.l. 34–36, tubules

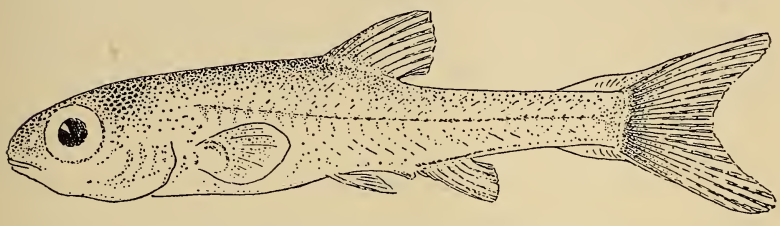


Fig. 20.—*Barbus phlegethon.* Juvenile, 13 mm.

complete, seldom one or two absent posteriorly; l.tr. 4–5 between dorsal spine and l.l., 3 between latter and base of ventral spine; around caudal peduncle 12; predorsal 14–15.

Up to 55 mm. Silvery, rather heavily tinted with brownish above, after preservation a dark lateral stripe ending in a more or less defined and rather large spot on end of caudal peduncle; fins pale greyish,

Barbus phlegethon.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
13	$3\frac{3}{4}$	$2\frac{1}{3}$	e > s	e > i	N	o scales	s	..	None	Dorsal, anal and ventrals developed.
15	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,		,,	..	..	,,	
17	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,	30	12	..	1+3	,,	
19	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,	31	12	4	1+4	,,	
21	$3\frac{1}{2}$	$2\frac{1}{2}$	,,	,,			..	..	,,	
23	$3\frac{1}{2}$	$2\frac{3}{4}$	,,	1	31–		..	..	,,	
25	$3\frac{1}{2}$	3	,,	1	33		4–5	2+4	(p)	
32	$3\frac{1}{2}$	3	,,	1			..	..	p	
35	$3\frac{1}{2}$	3	,,	1			..	..	..	Red patches begin.
37	$3\frac{3}{4}$	3	,,	1						
40	$3\frac{4}{5}$	$3\frac{1}{4}$	1	1+		12	5–6	2+6		
42	$3\frac{4}{5}$	$3\frac{1}{4}$	1	1						
44	$3\frac{4}{5}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$	34–36		..	..	..	♂.
47	$3\frac{4}{5}$	$3\frac{1}{3}$	1	$1\frac{1}{4}$			6–7			
50	4	$3\frac{1}{2}$	1	$1\frac{1}{4}$						
55	4	$3\frac{1}{2}$	1	$1\frac{1}{3}$			7–8	2+6 or 7	..	♂, ovig. ♀.

the fork of each branched ray in dorsal and anal rather dark, giving the semblance of a band when the fin is partly open; base of dorsal, ventral, most of caudal and anal, axil and base of pectoral brilliant red, beginning to develop at about the 35-mm. stage.

Locality.—Boontjes River, Citrusdal, a tributary of the Olifants River, and in the main Olifants River at Keerom (south of Citrusdal), Clanwilliam Division, Cape (A. C. H., K. H. B., and C. W. T., April 1937 and 1938, February 1939) (fig. 6).

Remarks.—This species rivals *calidus* in the brilliancy of the red splashes on the fins. It is distinguished from *calidus* by the non-serrate dorsal spine, the shape of the anal fin (see fig. 15, *d*) and the single pair of barbels.

Barbus anoplus Weber, forma *typica*

Gouritz River Chubby-head.

Fig. 21 (head).

1897. Weber, *l.c.*, p. 151 (part: only the Buffels River, Laingsburg, specimens).

1938. Barnard, *l.c.*, p. 84.

[Not Boulenger, *l.c.*, 1911, p. 177, fig. 155. = *asper*, *senticeps*, and probably other species.

Not Gilchrist and Thompson, *l.c.*, 1913, p. 428, fig. 87. = *asper*, *tenuis*, and probably other species.

Not Boulenger, *l.c.*, 1916, p. 272. = *pallidus* (*fide* Trewavas).

Not J. L. B. Smith, *l.c.*, 1937, p. 124, pl. 29, fig. 2, figure after Boulenger. = *senticeps*.

Probably not Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 430, 1934, and lxxxvii, p. 371, 1935. Natal.]

The first point to be emphasized in discussing this species is that it is *not* a red-fin.

Gilchrist and Thompson had no specimens of the true *anoplus*. Boulenger appears not to have examined the types, because, if he had done so, he could not have failed to notice the striking difference in "facies" between the true *anoplus* and the specimens he assigned to Weber's species. The specimens recorded in 1916 are really *pallidus* according to information given me by Dr. Trewavas.

Thanks to Dr. de Beaufort, I have been able to examine the type series from the Buffels River, Laingsburg, comprising over 100 specimens from 22 mm. up to 87 mm. The largest specimen measured

to the end of the caudal lobes 95 mm., thus corresponding with the measurement given by Weber; it has had the mouth cut and the gill-rakers on one side extracted.

From this series and the very large amount of material recently collected by the South African Museum, the following diagnosis has been compiled.

Proportions as in table, p. 209. Snout short, in adult equal to, in very large specimens very slightly longer than eye, bluntly rounded like that of the European Chub (hence "Chubby-head") (see fig. 21). Mouth terminal. Lower labial grooves interrupted medianly. A single (posterior) barbel on each side, $\frac{1}{2}$–$\frac{3}{4}$ eye-diameter, developing at about the 24-mm. stage. Gill-rakers 2 + 5–7 on anterior arch. No tubercles on head in ♂.

D iii. 7 (actually 4 spines, true 1st very small, and obscured in adult), hindmost spine thin, flexible, non-serrated. A iii. 5. Pectoral reaching to or nearly to base of ventral in ♂, shorter in ♀. Base of ventral fin below dorsal spines in juv., but shifting slightly forwards so that in adult base of the last ray is below 1st dorsal spine.

Scales with very numerous (20–28) radiating striae; scaling beginning before the barbel is developed, at about the 23-mm. stage. Lat.l. 33–35, tubules variously interrupted and incomplete, sometimes only half a dozen anteriorly; l.tr. 5–6 between dorsal spine and l.l., 4 between latter and ventral spine; 16 around caudal peduncle; 13–14 or 15 predorsal.

Colour of the living fish: metallic silvery, greenish or greyish above, with a more or less pronounced yellow or golden tinge in ♂, more greyish in ♀; fins whitish, without either red patches at their bases or any pinkish suffusion, but in ♂♂ they may partake of the yellow tinge, especially the caudal fin. After preservation there is a more or less conspicuous dark lateral stripe, not expanding at end, but ending in a small more or less indistinct spot.

The smallest ovigerous ♀ examined was 35 mm. in length. Spawning, as far as observations have gone, takes place from September onwards to March and April.

Weber's insistence on the pectoral fin not reaching the base of ventrals is curious, as there are several ♂♂ in his Laingsburg material in which the pectoral does reach almost to the ventrals.

Weber noted the more pointed snout and higher dorsal fin in the Klip River, Natal, specimens, but nevertheless included them with *anoplus*. I have seen the specimens; they show several other differences, and are certainly not *anoplus*, nor *karkensis* (see p. 216).

The French Hoek specimens, also included in *anoplus* by Weber, are young *burchelli* in the "single-barbel" stage (see p. 186).

B. karkensis G. and T., regarded by Boulenger (1916, p. 272) as a synonym of what he thought was *anoplus*, is quite different from the true *anoplus* (*karkensis* has a complete lateral line, see *infra*, p. 215).

Gilchrist and Thompson's "*anoplus*" material (except the Albany

Fig. 21.—*Barbus anoplus*. Head of adult of typical form and forma *cernuus* (but not forma *oraniensis*, which has shorter barbel). Juvenile of forma *cernuus*, 13 mm., Olifants River, Clanwilliam.

Museum specimen which I have not seen) consists of *asper*, *tenuis*, and other species, on the identity of which latter I express no opinion except that they are not *anoplus*.

South African Museum material, including recent collecting, shows that this species occurs throughout the Gourtiz River system: Verkeerde Vlei and Touws River; Gamka River at Letjesbosch, Kruidfontein, and Gamka Poort (Zwartberg Range); Bushman River, tributary of the Gamka River, near Letjesbosch; Buffels River, Laingsburg, and its continuation (Groote River) at Ladismith; Le Roux River, Oudtshoorn; Langtouw River, Herbertsdale.

I have also seen 3 specimens, which *appear* to be conspecific, from

a dam at Bedford, in the Great Fish River system (F. G. Chaplin coll.).

Up to the present, however, recent collecting has failed to find this species in any river-system south of the main Cape watershed except the Gouritz River system (fig. 6).

Note on a locality in the Karroo. In March 1937 Dr. Boonstra and Mr. Thorne discovered a colony of this species on a farm near the Bushman River, a tributary of the Gamka River, near Letjesbosch. In April 1939 they took me to see the place. No one would dream of looking for fish in such a locality. It affords a very striking example of subterranean pools or reservoirs enabling fish to maintain their existence in what is on the surface a drought-stricken area.

A small spring arises on the farm, and the farmers have enlarged the opening and cut a channel, 2–3 feet wide, back into a low hill, so that now the water comes out of the rock about 10 feet below the surrounding surface. It is about 50 yards from the nearest tributary stream leading to the Gamka. Except for short periods after heavy rain this "stream" is only a dry stream-bed, and the Gamka itself at this part of its course is only a periodic river. The spring, however, is perennial, and must be fed from underground sources, as the local rainfall is certainly insufficient to keep it flowing. At the time of our visit the fish were there in large numbers, of all sizes.

On a neighbouring farm where a spring forms a surface pool no fish were found, although it also is perennial.

Barbus anoplus forma *typica*

Buffels (Groote) River, Ladismith.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
18	$3\frac{1}{4}$	$2\frac{3}{4}$	e > s	1	N	o scale	s	..	None	Fin rays distinct.
20	$3\frac{1}{3}$	3	,,	1		,,		..	,,	
23	$3\frac{1}{3}$	3	,,	1	32–33	14	8–10	1+4	,,	
25	$3\frac{1}{2}$	3	,,	1		14	10–12	2+5	(p)	
30	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1		14–16	12–14	..	p	
35	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	1		16	14–16	2+6–7	p	♀ ova.
40	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	1			16–18	..	..	♂♂♀♀ ova.
45	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$			..	..	..	♂♂♂♀♀♀ ,,
50	$3\frac{1}{2}$	$3\frac{1}{2}$	1	$1\frac{1}{3}$	33–35		24–26	..	..	♂♂♂♀♀♀ ,,
55	$3\frac{2}{3}$	$3\frac{2}{3}$	1	$1\frac{1}{3}$–$1\frac{1}{2}$		16	..	..	..	♂♂♂♀♀♀ ,,
60	$3\frac{3}{4}$	$3\frac{2}{3}$	1	$1\frac{1}{2}$			30	2+6–7	..	♂♂♂♀♀♀ ,,
70	$3\frac{3}{4}$	4	1	$1\frac{3}{4}$			32–34	..	..	♂♂♀♀♀ ,,
80	4	$4\frac{1}{4}$	$1\frac{1}{5}$	2			..	..	..	♀♀ ova.
87	4	$4\frac{1}{2}$	$1\frac{1}{4}$	2			36–38	2+6–7	$\frac{3}{5}$ eye	♀ ,,

Barbus anoplus forma *oraniensis* nov.

Orange River Chubby-head.

1911. Boulenger, *l.c.*, p. 146 (no. 4, juv., Deelfontein, recorded as *burchelli*).

Since my proposal to give the Clanwilliam Olifants River form a separate specific name, a large series of specimens has been obtained from the north-eastern and southern tributaries of the Orange River.

Although this paper deals only incidentally with the Orange River fish-fauna, some account of this form is necessary. A table of characters at successive stages is given for comparison with those of typical *anoplus* and f. *cernuus*.

The table shows a closer approximation to *cernuus* than to *anoplus* in the L/H and H/E proportions; but there is a lag in the development of the scales, especially of the full complement around the caudal peduncle, as in typical *anoplus*. The lateral line tubules are greatly reduced, often appearing on the anterior scales only.

This form differs from both *anoplus* and *cernuus* in the very short barbel, and the later period at which it develops. No trace of an anterior barbel was found in any of the 1300 specimens examined.

Localities.—Laken Vlei River, Merriman (Richmond Division), a tributary of the Ongar River (K. H. B., L. D. B., and C. W. T., April 1939); Zak River, Williston (Calvinia Division) (R. Smithers, March 1939; K. H. B., L. D. B., and C. W. T., April 1939) (fig. 6). All the following collected by C. W. T., L. D. B., A. J. H., Oct.–Nov. 1939: Dry Hartz River at Taungs; Vaal River at Warrenton; Modder River and tributaries near Boshof, Bloemfontein, and Dewetsdorp; tributary of Caledon River at Smithfield; Stormberg River near Burghersdorp; Brandspruit north of Steynsburg; Oorlogspoort River south-east of Colesberg; and Sea-Cow (Seekoe) River near Hanover.

Remarks.—Thanks to Mr. Norman, I have examined Boulenger's no. 4 specimen from Deelfontein, a locality near Merriman. At first glance the "Chubby-head" was sufficient to indicate that, as I suspected, it was not *burchelli*.

Both the Ongar and the Zak rivers are in the Orange River system, and arise on the northern slopes of the main Cape watershed. To the west of the Zak River there is a tributary (Fish River), between which and the source of the Oorlogs River (a tributary of the Clanwilliam Olifants River) there is an ill-defined watershed. Further, the sources of the Tanqua River (Olifants system), Fish River

(Orange system), and Buffels River (Gouritz system) approximate in the Division of Sutherland; the Tanqua being separated from the Buffels by the Klein Roggeveld Mts., and both from the Fish River by the Roggeveld–Komsberg escarpment. Intercommunication in past times has certainly been possible.

It is not possible, however, to decide whether the original "*anoplus*" stock was spread over all three river-systems, or whether one river has been stocked from another by river-capture or intercommunication during sheet-flooding. It seems probable that *anoplus* and f. *cernuus*, being almost indistinguishable, have been isolated from the Zak River stock for a longer period than they have from one another.

Recent investigations have traced the presence of this form of *anoplus* in some of the other southern and north-eastern affluents of the Orange River. If the occurrence of *anoplus* in the Gt. Fish River (Eastern Cape Province), or in the Sundays River (which has not yet been investigated), were confirmed, it would form a parallel with the occurrence in the Gouritz River, as both systems arise on the main watershed opposite to the southern tributaries of the Orange River. In former times intercommunication may have been easier than it is to-day.

The Orange River itself might repay investigation. As no *anoplus* were found by Dr. Hesse and Mr. Thorne at Goodhouse and Aiais, *i.e.* in the section below the Aughrabies Falls, the possibility should be borne in mind that the fauna of the Orange River may not be homogeneous.

Recent (Nov. 1939) results obtained by Mr. Thorne, in company with Dr. Hesse and Dr. Boonstra, confirm the above statement that the fish-fauna of the Orange River is not entirely homogeneous. Whereas *paludinosus* has been found only in the lower and middle sections and the northern and north-eastern tributaries, but not in the southern tributaries, *anoplus* occurs in the northern and north-eastern *and* the *southern* tributaries, but not apparently in the lower and middle sections.

It is indeed remarkable that, in spite of its evidently wide distribution in the southern tributaries (as well as in the Vaal, etc.), neither *anoplus*, nor any other species with radiately striate scales and only one pair of barbels, has been recorded from the lower and middle sections of the Orange River.

Although formerly it seemed justifiable to give the form from the Clanwilliam Olifants River (*cernuus*) full specific rank, I now

think that the geographical distribution can be better expressed and the factors leading to this distribution more readily discussed by uniting all three forms under one specific name. The Gouritz River form must for taxonomic reasons be regarded as the typical form, although chronologically it *may* be the latest offshoot from the ancestral stock.

Barbus anoplus forma *oraniensis.*

(Merriman and Zak River, Williston.)

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
14	$3\frac{1}{5}$	$3\frac{3}{4}$	e < s	1	None		..	1+4	None	Fin rays distinct, no ventral lamina.
15	$3\frac{1}{4}$	3	,,	1	,,		..	..	,,	
18	$3\frac{1}{3}$	3	,,	1	,,		..	..	,,	
20	$3\frac{1}{2}$	3	,,	1	,,		..	1+4	,,	
22	$3\frac{1}{2}$	3	,,	1	,,		..	..	,,	
23	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1	(32	12)	..	..	,,	Scales scarcely distinct.
25	$3\frac{1}{2}$	$3\frac{1}{3}$	,,	1	33	14	12	..	,,	
30	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$		14	..	..	(p)	
35	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$		14	14–16	..	(p)	♂.
40	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	$1\frac{1}{4}$		14–16	..	2+5	$\frac{1}{8}$ eye	♂♀.
45	$3\frac{3}{4}$	$3\frac{2}{3}$	,,	$1\frac{1}{3}$	33–35 (36).		..	2+5 or 6	$\frac{1}{6}$ eye	♂♀.
50	$3\frac{3}{4}$–$3\frac{4}{5}$	$3\frac{3}{4}$–4	1	$1\frac{1}{2}$			20–22		$\frac{1}{4}$–$\frac{1}{3}$ eye	
55	$3\frac{4}{5}$	4	1	$1\frac{1}{2}$						♂·♀.
60	$3\frac{4}{5}$–4	$4\frac{1}{4}$	1	$1\frac{2}{3}$			26		$\frac{1}{3}$ eye	
65	4	$4\frac{1}{2}$	$1\frac{1}{6}$	$1\frac{3}{4}$		16				
70	4	$4\frac{2}{3}$	$1\frac{1}{5}$	2			28		$\frac{1}{2}$ eye	♂♀.
75	4	$4\frac{3}{4}$	$1\frac{1}{4}$	2						♀.
80	4	$4\frac{4}{5}$	$1\frac{1}{4}$	2						♀.
85	4	5	$1\frac{1}{4}$	2	37		32		$\frac{1}{2}$ eye	♀.

Barbus anoplus forma *cernuus*

Clanwilliam Chubby-head.

Fig. 21 (head, and juv.).

1938. Barnard, *l.c.*, p. 88 (*cernuus*).

Depth of body $3\frac{1}{2}$, length of head $3\frac{1}{2}$ (juv.), 4 (adult) in length of body (excluding caudal fin). Eye 3 (juv.), 4 (adult) in length of head, subequal to snout from about the 30-mm. stage upwards, 1 (juv.), $1\frac{1}{3}$ (adult) in interorbital width. Snout rounded, mouth terminal. Lips thin, lower labial grooves interrupted for only a short distance medianly. Normally, from 22 mm. upwards, only the posterior barbel on each side, $\frac{1}{2}$–$\frac{2}{3}$ (scarcely ever $\frac{3}{4}$) eye-diameter in length; occasionally in medium-sized specimens the anterior

barbel is feebly developed. Gill-rakers 2+4 or 5 on anterior arch, feebly developed. No tubercles on head in ♂.

D iii. 7, the 3rd spine about equidistant from the last scales on caudal peduncle and from tip of snout; 3rd spine about $\frac{4}{5}$ length of head, thin, flexible, non-serrate. A iii. 5. Pectoral extending to about $\frac{3}{4}$ the distance between its (upper) base and base of ventral spine in ♂, $\frac{2}{3}$ the distance in ♀. Ventral spine arising in vertical from 3rd dorsal spine, slightly more forward in juveniles. Caudal peduncle about $1\frac{1}{4}$ or $1\frac{1}{5}$ as long as deep.

Scales radiately striate, striae numerous, about 20–25 in adult, l.l. 31–35, tubules usually nearly complete, but not seldom interrupted or incomplete posteriorly, l.tr. 6 between dorsal spine and l.l., 3 between latter and ventral spine; around caudal peduncle 12 in very young, 14 up to about 45 mm., usually 16 in adult; predorsal 14–15.

Up to 70 mm. Silvery, slightly brownish above, with bright yellow or golden tinge in ♂, and a pinkish or violet sheen in ♀; after preservation a more or less conspicuous dark lateral stripe, ending usually in a small spot at end of caudal peduncle; fins pale, without red patches or any pinkish suffusion.

Locality.—Olifants River at Keerom, south of Citrusdal; Boontjes River, Doorn River, irrigation furrow at Klaver, and Troe Troe River at Van Rhyns Dorp—all in the Olifants River system, Clanwilliam Division, Cape (long series collected by the late A. E. Manley, A. C. H., K. H. B., C. W. T., 1936, 1937, 1938, 1939) (fig. 6).

Remarks.—This small species is easily distinguished from the other species of *Barbus* found in the Olifants River by its bluntly rounded snout with terminal mouth, numerous radiating striae on the scales, and the absence of red-fins. The terminal mouth is distinctive even in juveniles, which, moreover, are distinguished from those of *calidus* by their non-serrated dorsal spine, and from those of *phlegethon* by their scales and (after preservation) paler colour.

On the other hand, it is so like typical *anoplus* that I doubt whether isolated specimens could be satisfactorily distinguished on *morphological* characters (unless a rudimentary anterior barbel is present). The proportions of the head, and of the eye are slightly different, the striae on the scales are slightly more numerous in typical *anoplus*, the ventral fin is slightly more forward in *anoplus*, but the difference is scarcely tangible; the lateral line tubules are usually nearly complete in *cernuus*, but in typical *anoplus* very far from complete, often greatly reduced. Where a feature is inconstant, the inconstancy

cannot be used to differentiate varieties and races, as is justly noted by Hora, Misra and Malik (1939, Rec. Ind. Mus., xli, pp. 268, 269).

But when the life-histories of the two forms are compared, there is seen to be a distinct lag in the development of the scaling and the barbel in the case of typical *anoplus*. On the other hand, the full

Barbus anoplus forma *cernuus*.

TL	L/H	H/E	S/E	I/E	l.l.	c.ped.	striae.	g.r.	barb.	Sex and Remarks.
11	$3\frac{1}{2}$	3	e < s	1	No scales			..	None	Ventrals not free. Dorsal and anal fin rays distinct.
13	$3\frac{1}{2}$	3	,,	1		,,		..	,,	Ventrals just free.
15	$3\frac{1}{2}$	3	,,	1		,,		..	,,	Ventral lamine almost gone.
16	$3\frac{1}{2}$	3	,,	1	31	12	10–12	..	,,	No ventral lamina.
20	$3\frac{1}{2}$	3	,,	1	33	14	12–14	1+4	,,	
22	$3\frac{1}{2}$	$3\frac{1}{4}$	,,	1		14	..	..	(p)	
25	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	1		14	16–18	2+4	p	
30	$3\frac{1}{2}$	$3\frac{1}{2}$	,,	1		14	..	..	p	
35	$3\frac{2}{3}$	$3\frac{3}{4}$	1	$1\frac{1}{3}$		14	18–20			
40	$3\frac{2}{3}$	$3\frac{4}{5}$	1	$1\frac{1}{3}$		14				
45	$3\frac{2}{3}$	$3\frac{4}{5}$	1	$1\frac{1}{3}$	33–35	14–16	22–24			
50	$3\frac{3}{4}$	$3\frac{4}{5}$	1	$1\frac{1}{3}$		14–16	..	2+5	..	♂, ovig. ♀.
55	$3\frac{4}{5}$	4	1	$1\frac{1}{3}$		16	..	..	..	♂, ovig. ♀.
57	4	4	1	$1\frac{1}{3}$		16	26–28	..	..	♂, ovig. ♀.
60	4	4	1	$1\frac{1}{3}$–$1\frac{1}{2}$		16	..	..	..	♀ ovig.
65	4	4	1	$1\frac{1}{2}$		16	..	2+5	..	♀ ovig.
70	4	$4\frac{1}{5}$	1	$1\frac{2}{3}$		16	28–30	2+5(6)	$\frac{2}{3}$ eye	♀ ovig.

complement of 16 scales around the caudal peduncle is reached a little sooner in *anoplus* than in *cernuus*.

A curious feature of *cernuus*, which has not been observed in typical *anoplus* or forma *oraniensis*, is the occasional, and sometimes asymmetrical, development of the anterior barbel. This has been noticed in 17 specimens out of 250 (counting only those from 30 mm. in length upwards). In all cases it was only feebly developed, and occurred only in specimens between the lengths of 30 and 55 mm.: on both sides in 7 specimens, only on the left in 4, and only on the right in 6.

For these reasons the maintenance of two specific names formerly seemed to me to be justified. But the advent of the Orange River material has caused me to revise this opinion. The very close relationship of the two forms is assuredly correlated with the close topographical approximation of the headwaters of the respective river-systems, the Olifants (*cernuus*) and Gouritz (*anoplus*). The two

systems abut on the main Cape watershed, and especially at Karroo Poort the headwaters of the Doorn River (Olifants system) and the Touws River (Gouritz) are at the present day separated only by low-lying country. In earlier times when the whole country was lower and the watershed less elevated or developed, it is possible, nay probable, that some interconnection existed.

Very early stages and ovigerous ♀♀ were caught in November, February, March, April.

The Clanwilliam Chubby-head is hardy in captivity, examples having been kept by Mr. Harrison for two years. They have a curious habit, while floating in the water, of bobbing the head down and up, as if making obeisance to some invisible Fish-god.

Barbus karkensis G. and T.

Gillieminkie or Gillie (*Eastern Province and Natal*).

1913. Gilchrist and Thompson, *l.c.*, p. 430.

1916. Boulenger, *l.c.*, p. 272 (synonym of *anoplus*).

1934. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 431 (? part only).

Although there is no fresh material from the type locality, Mr. Harrison has recently collected material which appears to be this species. In view of its similarity with *anoplus*, and the distributional questions raised thereby, some notes on this material are given.

There are no specimens under 30 mm. in length, consequently nothing can be said as to the stage at which the barbel and scaling develop.

All the stages above 30 mm. up to 87 mm. agree with the table given for *anoplus* forma *typica* (p. 209), except in one feature. The lateral line tubules are continuous and complete, except on the hindmost 2–5 (sometimes 6) scales on the caudal peduncle; sometimes the tubules are missing only from the last scale.

Gilchrist and Thompson's type (73 mm. to end of middle caudal rays) also agrees.

The striae on the scales, although numerous, are slightly fewer than in *anoplus*.

The completeness of the series of lateral line tubules, and the fewer striae on the scales, seem to be the only morphological differences between *karkensis* and *anoplus*, although the snout is not quite so blunt and rounded in *karkensis* as it is in *anoplus*.

The Gillieminkie is not a "red-fin." In other respects the coloration appears to be the same as in *anoplus*. In some specimens, as

preserved, there is a distinct yellowish tinge, those which show it best being males (as in *anoplus*); and at Kokstad Mr. Harrison's attention was drawn to these yellow specimens.

Localities.—Tugela River system: Helpmakaar, Natal (Fowler); Driefontein, Ladysmith, Natal (ex Natal Museum). Umgeni River system: Karkloof, Natal (Gilchrist and Thompson). Umzimhlava River system: Kokstad commonage, Eastern Griqualand) (A. C. H.). Gt. Kei River system: Kubusie River at Stutterheim (A. C. H.); Nahoon River at Berlin (A. C. H.). Buffalo River system: Tyusha stream at Pirie (A. C. H.). Gt. Fish River system: dam at Bedford (F. G. Chaplin, 1933). Vaal River system: Bethlehem, O.F.S (Fowler).

Fowler says (*l.c.*, p. 431) only first 10 lateral line scales are tubular "in young"; he records specimens of 50–63 mm. from Bethlehem, 58 mm. from Helpmakaar, and 55 mm. from "Zwartsberg River," * none of which can be called young. In the present material the lateral line tubules are developed and complete at the 35–40-mm. stage. And I have seen a single specimen from Harrismith (also Vaal River system) with incomplete lateral line. Consequently I am inclined to think that Fowler's description is composite. Much more material is required from the Bethlehem-Harrismith area before one can say whether the Vaal River specimens are a form of *anoplus* or true *karkensis*.

No investigation has yet been made of the southern Natal area between the Umgeni River system and the Umzimhlava system (Umkomaas and Umzimkulu rivers). And as regards the south-westerly limit of *karkensis*, the area between the Gt. Fish River and the Sundays River, including the Bushmans and Sundays rivers, has also not yet been investigated.

I have seen Weber's Klip River specimens, 11 in number, from 32–55 mm. in length. Although very similar to both *anoplus* and *karkensis*, they differ in certain respects. From *anoplus* they differ in having a complete series of lateral line tubules, and slightly fewer striae on the scales; and at 50 and 55 mm. (ovig. ♀) they have not developed more than 14 scales around the caudal peduncle.

The two former characters bring them into agreement with *karkensis*, but in the latter character they differ from *karkensis* as well as from *anoplus*, in both of which species specimens of 30–40 mm. typically exhibit 16 scales around the caudal peduncle. Weber's specimens cannot therefore be included with *karkensis*, but no conclusions should be drawn from so small a series.

* It is impossible to say where this locality is.

The same applies *a fortiori* to a single specimen from Howieson's Poort, Kariega River system (ex Albany Mus.), which is 50 mm. in length with only 14 scales around the caudal peduncle.

Barbus afer Peters

1864. Peters, MB. Ac. Wiss. Berlin, p. 395.

1868. Günther, Cat. Fish. Brit. Mus., vii, p. 148.

1938. Barnard, *l.c.*, p. 85.

[Not Boulenger, *l.c.*, 1911, p. 178, fig. 156, the description is composite, the recorded specimen and its figure = *burchelli*.

? Pellegrin, Bull. Soc. zool. Fr., xlv, p. 148, 1920. Name only. Upper Zambezi.

? Fowler, Proc. Ac. Sci. Philad., lxxxvi, p. 431, 1934. Natal and Cape Province. 35 and 37 mm.

Not Gilchrist and Thompson, *l.c.*, 1913, p. 430, fig. 88. After Boulenger.]

Thanks to the kindness of Dr. E. Ahl of the Berlin Museum, I was able to examine one of three specimens labelled as types (Cape of Good Hope, coll. Krebs), preserved in that Museum. Dr. Ahl said all three specimens were in poor condition. The specimen sent to me was an ovigerous ♀ measuring 100 mm. in length; it had lost most of its scales, but as these are of large size, the scale-pockets could be counted with reasonable accuracy.

Depth of body approximately (the belly was very flabby) 4, length of head 4 in length of body (excluding caudal fin). Eye 4 in length of head, subequal to snout, $1\frac{2}{3}$ in interorbital width. Mouth terminal or subterminal. One barbel on each side, subequal to eye-diameter. Gill-rakers $2 + 6 - 7$ on anterior arch.

D iii. 7. 3rd spine thin, flexible, non-serrated, slightly shorter ($\frac{4}{5}$) than length of head, origin of 1st spine midway between tip of snout and base of middle caudal rays. Pectoral not reaching ventral (♀), the latter arising below dorsal spines. A iii. 5. Scales large, striae few (about 8), l.l. 27, c.ped. 12, tr. 4 (5) between dorsal spines and l.l., 3 between l.l. and ventral spine, between l.l. and base of anal 3 anteriorly, 2 posteriorly; 12 predorsal (no scales left, pockets counted); lateral line tubules present on scales 1–6, 12–15, 18, 19, and 25, absent on 20th scale right side, and 26th and 27th scales left side, other scales missing; l.l. therefore probably complete or nearly so.

Note on Barbus viviparus *Weber*

1941. Barnard, Ann. Mag. Nat. Hist. (xi), 8, p. 469.

On account of the alleged viviparity of this species, and also of its resemblance to *pallidus*, I thought it desirable to re-examine the original material. Thanks to the kindness of Dr. de Beaufort of the Amsterdam Museum, I have been able to do this; and a brief note has been published (*l.c.*, *supra*).

Weber (Zool. Jahrb. Abt. Syst., x, 1897, p. 153) stated that he took embryos, 8 mm. in length, with large yolk-sacs, from a ♀ 53 mm. in length. As Weber remarked, no case of viviparity among the *Cyprinidae* was known. So far as I am aware, these observations have not been commented upon, or confirmed.

In the material loaned to me, there were one large and one small specimen from Isipingo, and 25 specimens, 17–49 mm. in length, from the Umhloti River, Verulam. The large Isipingo specimen measures 64 mm. to the end of the caudal lobes, and a 49-mm. specimen measures 53 mm., thus conforming with the measurements given by Weber.

None of these specimens had been opened for purposes of sexing. Neither the specimen from which Weber took the embryos, nor any of the embryos, were included in the material.

I opened all the specimens sent to me, and found that the sexes could be distinguished in specimens from 35 mm. in length upwards. Most of them were males; the 59-mm. Isipingo specimen, and 3 Verulam specimens, 45–49 mm., were females.

The ovaries in all the ♀♀ were in all respects normal, containing a *large number* of *normal-sized* ova. The ♂♂ were *without intromittent organs*. I failed, therefore, to find any evidence suggesting that this species is viviparous.

Later, Dr. de Beaufort informed me (15/iv/39) that there were two more specimens in the Amsterdam Museum: one ♀ "with embryos in the ovarium," mounted in the exhibited collection; and another ♀ which had been cut open and "the embryos fallen out of the body-cavity and lying on the bottom of the glass." The former specimen could not, of course, be sent to me, but Dr. de Beaufort very kindly sent the latter.

Examination of this specimen showed that the stomach and intestines had been removed, the ovaries were nearly intact and contained a large number of normal-sized ova (as in the previous lot of

specimens), and the supposed embryos lying loose in the tube were really the fry of a Cichlid!

Weber (*l.c.*, p. 148) mentions that he obtained young fry from the mouths of "Chromis philander" in the Umhloti River at Verulam, one of the localities where he obtained *B. viviparus*. And in the tube of 25 *B. viviparus* from Umhloti River, previously sent to me, there were also 8 small Cichlids. The explanation, therefore, seems to be that in the exigencies of field-collecting, all these specimens were preserved together; later one ♀ *viviparus* had been put in a separate tube together with the Cichlid fry assumed to be its embryos.

The investigation has thus been narrowed down to a re-examination of the ♀ mounted in the exhibition collection at Amsterdam to see whether: (*a*) the young are actually *in utero* (not perchance in the stomach or intestine, indicating that the *Barbus* had been feeding on them, which is unlikely), and (*b*) they are actually young *Barbus*.

Pending this re-examination and confirmation of Weber's statements, in view of the above evidence and the novelty of the phenomenon of viviparity in a Cyprinid, the specific name "*viviparus*" must be regarded as a misnomer, although of course nomenclatorily it remains valid.

The following notes on diagnostic characters may be useful. *B. viviparus* is a pretty little species, resembling *pallidus* in many respects, but with different markings in preserved specimens. It has, as Weber described, a thin dark lateral streak ending in a round spot on the end of the caudal peduncle. In Weber's types (collected 1894–5) the tubuliferous lateral line is not dark; in Boulenger's Durban specimen (1911, *l.c.*, p. 170) it is dark. The dark spot on either side of the base of the anal fin is distinct at all stages (cf. *pallidus*).

Length of head in length of body changes from $3\frac{1}{3}$ (17-mm. stage), $3\frac{1}{2}$ (20 mm.), $3\frac{3}{4}$ (25 mm.), to 4 (35 mm. upwards); diameter of eye in head from $2\frac{1}{2}$ (20 mm.), 3 (25 mm.), $3\frac{1}{4}$ (40 mm.), $3\frac{1}{2}$ (45 mm.), $3\frac{3}{4}$ (49 and 59 mm.). Up to about 45 mm. the eye is slightly greater than the snout, only after that stage being subequal to it. The 17-mm. specimen is mutilated, but at the 20-mm. stage the scales and the posterior barbel are present, and the anterior barbel is just visible as a mere knob; at 23 mm. the latter is easily discernible.

The striae on the scales are few, not more than about 5 or 6, sometimes 7; and a feature of those in the largest specimens is the incompleteness of the striae (not reaching the hind margin of scale).

Predorsal scales 10–11, usually 10. The dorsal and anal fin

formulas are given as D iii. 8 and A ii. 5. These may be regarded as normal. But among the 27 specimens examined there were 3 (one of them being the mutilated 17-mm. specimen, and one the large 59-mm. Isipingo specimen) with only 7 dorsal rays.* One other specimen had 6 anal rays. As a rule only 2 anal spines are visible, but in most cases, especially in the juveniles, 3 can be distinguished, the true 1st spine being very short.

Gen. Engraulicypris Gnthr.

1911. Boulenger, Cat. Freshw. Fish. Afr., ii, p. 209.

1913. Gilchrist and Thompson, Ann. S. Afr. Mus., xi, p. 436.

1917. Nichols and Griscom, Bull. Amer. Mus. Nat. Hist., xxxvii, p. 703.

1930. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxii, p. 39.

1934. Van der Horst, Ann. Transv. Mus., xv, p. 281.

1936. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxviii, p. 294 (with subgenera).

Engraulicypris gariepinus n. sp.

It is a little uncertain whether one or two South African species should be recognized. *E. brevianalis* Blgr., 1908, was founded on a single specimen from Zululand (37 mm.) with 12 branched anal rays and 52 scales in the lateral line. The number of gill-rakers was not given. In Boulenger (*l.c.*) the original description is supplemented by the inclusion of 3 specimens from the Dwaars River, Transvaal, viz. anal rays 12–13, scales l.l. 50–52, and gill-rakers about 15. Whether it is the type specimen, which has "about 15" gill-rakers, or the Dwaars River specimens, remains ambiguous.

In the South African Museum are the 7 specimens from the Dwaars River (Limpopo system) recorded in Gilchrist and Thompson's work, which are part of the original lot, 3 having been sent to Boulenger. These 7 specimens show the following features: D ii. 7. A iii. 12–14 (one specimen with 12, two with 13, and four with 14 branched rays). The number of gill-rakers is 10–11 (total number on 1st arch), Gilchrist and Thompson did not give the number of gill-rakers, but gave scales l.l. 52–55 (which numbers are confirmed herewith).

There are also 3 specimens from the Sabi River (Komati River system) which agree with the above 7 specimens in the number of gill-rakers; one, however, has D ii. 8, one has A iii. 14, and two have A iii. 15.

* Cf. *pallidus*, p. 194.

Further, 7 specimens from the Hluhluwe Reserve, Zululand (Dr. R. F. Lawrence, Natal Mus.): gill-rakers and scales as above, five specimens with 13, two with 14 anal rays, one with 8 dorsal rays (this specimen has 13 anal rays).

From the Orange River at Goodhouse I have over 1000 specimens, 11–55 mm. in length; and from the Gt. Fish River at Aiais, S.W.A. (a tributary of the Orange River), 106 specimens, 22–56 mm. in length. These show: D ii. 7–8. A iii. 15–17, gill-rakers 9–10, scales l.l. 45–48 (–49–50), caudal peduncle 16.

In 1934 van der Horst described a second South African species: *whitei*, from the Aapies River (Limpopo system), with A iii. 15–16, gill-rakers 12, and scales l.l. 58–59.

As van der Horst gives 3 anal spines, and the same number is constant in all my specimens, it may be assumed to be normal, and that the minute 1st spine was overlooked by Boulenger, and by Gilchrist and Thompson.

Counting the branched rays only, we see that a complete series can be obtained from comparatively few specimens (taking a haphazard sample of 20 from the Orange River specimens):—

Number of Specimens.	Number of Branched Anal Rays.	Material.	Authority.
1	12	Type of *brevianalis* (Zululand)	G. A. B.
1	12	Dwaars River (G. and T.'s material)	K. H. B.
2	13	,, ,,	,,
5	13	Zululand	,,
2	14	,,	,,
4	14	Dwaars River (G. and T.'s material)	,,
1	14	Sabi River	,,
2	15	,,	,,
9	15	Orange River	,,
9	13–16	Aapies River, *whitei*	v. d. H.
9	16	Orange River	K. H. B.
2	17	,,	,,

Similarly there is a continuous series as regards the scales in the lateral line from 47–55 and 58–59. This is not correlated with the number of anal rays; but, on the other hand, one may note that the number of gill-rakers decreases as the number of anal rays increases.

Although it may seem premature to give a name to the Orange River specimens, they are at least as distinct from *brevianalis* and *whitei* as these two forms are from one another, and I think no great

harm will come if they be recorded under the name *gariepinus* n. sp. (essential characters given above).

Before the limits of the species can be determined, a detailed analysis of abundant material from many more localities must be made. It is rather astonishing that hitherto no examples of *Engraulicypris* have been obtained from the upper reaches or tributaries of the Orange River. If the genus really is absent from the latter region, its presence in the lower section of the Orange River, below the Aughrabies Falls, and its tributary the Gt. Fish River, is even more remarkable.

Gilchrist and Thompson mentioned one feature which seems to have escaped the attention of Boulenger; they say the under surface of the lower jaw is either "entire" (=smooth) or covered with minute tubercles. They do not suggest that it is a sexual character; but to some extent it is. The lower surface of the lower jaw in the ovigerous ♀ has very minute tubercles or villi; in the ♂ these are much more numerous and distinct, and extend on to the symphysial and branchiostegal membranes, and the interopercle and lower border of the preopercle.

The very fine series from the Orange River and Gt. Fish River were collected by Dr. A. J. Hesse and Mr. C. W. Thorne of the South African Museum (Nov. 1936). When freshly caught the colour was pale yellowish-silvery; as preserved the whole body is silvery and there is a more or less obvious stripe along the side formed by minute pigment specks; dark specks are also present along the back, on the top of the head, snout, upper border (and to a lesser extent the lower border) of the eye-ball, and along base of anal fin; opercle, cheek, and iris brilliantly silvery, pupil black.

Family CLARIIDAE.

Clarias, the Mud-barbel, occurs in the Orange River system, but it need not be considered here, except to record the actual occurrence of *L. gariepinus* at Goodhouse on the Orange River, and at Aiais on its tributary the Gt. Fish River in South West Africa (A. J. H. and C. W. T., Nov. 1936) (fig. 22).

Family BAGRIDAE.

Gen. Gephyroglanis Blgr.

1911. Boulenger, *l.c.*, ii, p. 344.
1913. Gilchrist and Thompson, *l.c.*, p. 452.
1916. Boulenger, *l.c.*, iv, p. 304.

The distribution of this genus is discontinuous: Lake Chad, Ogowe River (French Equatorial Africa), Congo River, and the Orange River system.

Gilchrist and Thompson recorded two specimens from the Kafue River, a northern tributary of the Zambezi River. Mr. Drury, of the South African Museum, tells me he does not definitely remember catching this particular kind of Catfish; the specimens were not registered by Mr. W. W. Thompson at the time, merely put in a bottle

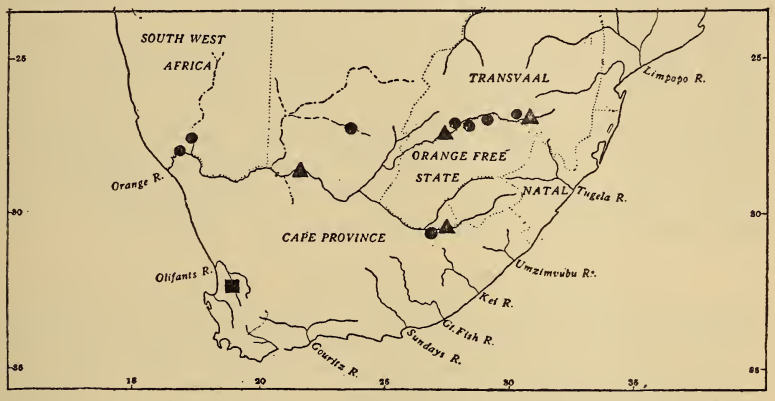


Fig. 22.—Map showing recorded localities of ● *Clarias gariepinus*, ▲ *Gephyroglanis sclateri* (in the Orange River system), and ■ *Gephyroglanis gilli* (in the Clanwilliam Olifants River).

with a pencilled label *outside*; and there is now only one specimen, instead of two. Confirmation of the locality seems desirable.

Dr. van der Horst (*l.c.*, *infra*) mentions *G. sclateri* from the Transvaal, but without definite locality.

Dr. J. L. B. Smith (*l.c.*, *infra*) gives Natal as a locality, but see *infra*, p. 227.

The recent discovery (September 1936, K. H. B. and C. W. T.) of specimens in the Clanwilliam Olifants River is one of the most surprising results of the investigation of the indigenous fish-fauna (fig. 22).

Of the species described in Boulenger's work, the Orange River species, *sclateri*, is the only one with obtuse or rounded caudal lobes.

The number of anal rays differs in each species, but appears to be characteristic, especially the number of branched rays. The anal fin is composed of short weak spines, longer simple rays, and branched rays. The spines are concealed under the rather thick skin; without dissection, and sometimes even after dissection, they are difficult to count. The simple rays are segmented, at least distally. The

branched rays in specimens up to about 75 mm. in length (both the Orange River and Olifants River forms) are simply bifurcate; but in those over this length each branch is split up, and the ray becomes quadrifurcate. In the largest specimen (Orange River) there may be 5 or 6 branches to each ray. The first ray, however, usually remains bifurcate, or only one of the branches splits (trifurcate). The last ray, which begins as a simple ray, becomes bifurcate, and remains so (in the smallest specimens, although simple, it is counted among the branched rays).

The Catfishes of this genus are distinguished from the marine Catfish *Galeichthys* (also called a Barbel): by the deep angle or notch in the gill-membranes on the lower surface; by the well-separated nostrils, the anterior nostril tubular, the posterior with a short barbel or tentacle; by the dorsal and pectoral spines being smooth on the front edges, the former is smooth also on its hind edge, only the pectoral spine being serrate on its hind edge.

Key to the Species.

1. Distance between anterior nostrils equal to distance between inner mental barbels, but *less* than distance between posterior nostrils; the distance between the latter equal to distance between outer mental barbels; the former distance 1½ in the latter. Orange River . . . . . *sclateri.*
2. Distance between anterior nostrils equal to distance between inner mental barbels, and also *equal* to the distance between posterior nostrils; this distance twice in the distance between outer mental barbels. Olifants River . . . . . *gilli.*

Gephyroglanis sclateri Blgr.

Orange River Rock-baager, or Cat-fish.

Fig. 23, *a*, *b*.

1911. Boulenger, *l.c.*, ii, p. 346, fig. 269.

1913. Gilchrist and Thompson, *l.c.*, p. 453, fig. 104.

1931. van der Horst, Ann. Transv. Mus., xiv, p. 246. (Transvaal, without definite locality.)

1934. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvi, p. 419.

1937. J. L. B. Smith, *l.c.*, p. 130.

Gilchrist and Thompson did not dissect the anal fin in their material, nor did Boulenger apparently. I find from an examination of 23 specimens that the composition of the fin does not quite agree with previous statements.

There are usually 4 spines, in two cases 3; in one case only 2; 2 or 3 simple rays; and 10–12 branched rays. The formula may be

2.2.12, 3.3.11 or 12, 4.3.10–12, 4.2.11 or 12; the most frequent being 4.2.12. The total number varies from 17 to 19; among the 23

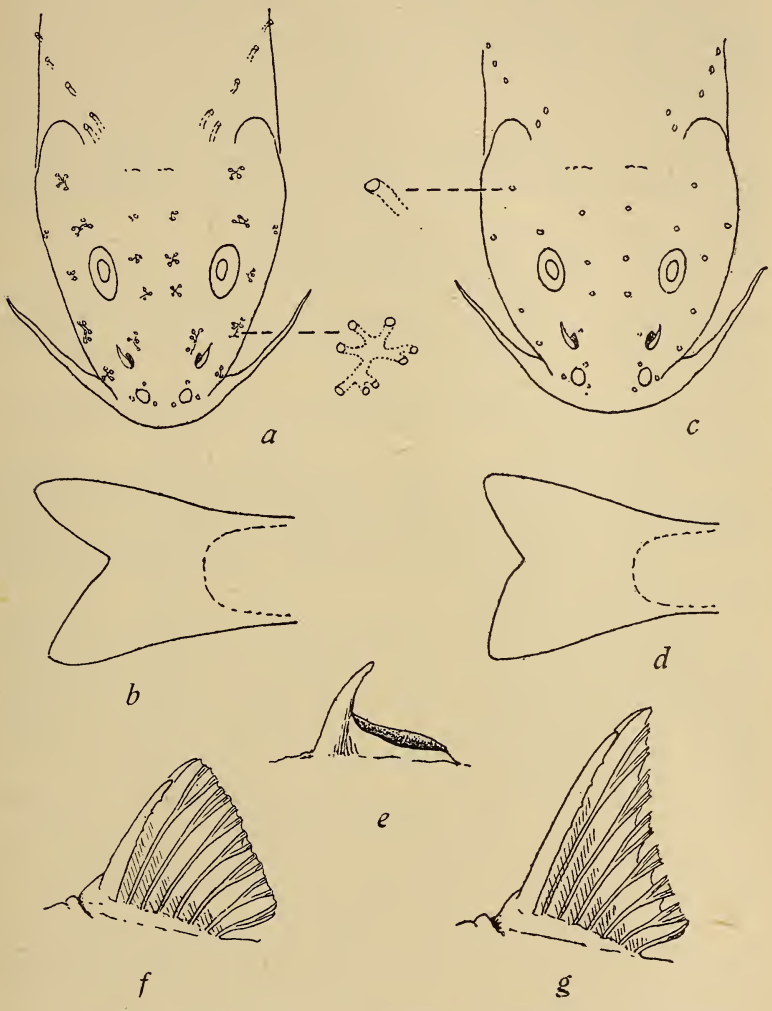


Fig. 23.—*Gephyroglanis. G. sclateri: a.* Dorsal view of head. *b.* Caudal fin. *G. gilli* n. sp.: *c.* Dorsal view of head. *d.* Caudal fin. *e.* Side view of posterior nostril. *f, g.* Low and high varieties of dorsal fin.

specimens there is one with 19 (4.3.12), 6 with 17, 15 with 18, and one with only 16. (The Kafue River specimen is included.)

In the dorsal fin there are, in 22 specimens, 7 rays, the last being

small and less branched than the preceding ones; in one specimen, 140 mm., there are 8 rays.

The large dorsal spine is preceded by a short, blunt, and more or less movable bony process, which might be regarded as the true 1st dorsal spine; but following Boulenger's practice only one spine is counted.

The dorsal fin varies in shape irrespective of age or sex (*cf.* fig. 23, *f*, *g* of *gilli*). In high fins the dorsal spine equals the distance from hind margin of opercle to posterior nostril; the 1st ray equals the distance from hind margin of opercle to anterior nostril. The dorsal spine is a little longer than the pectoral spine.

In low fins the dorsal spine and the 1st ray are equal to the distance from hind margin of opercle to, respectively, about midway between eye and posterior nostril, and to posterior nostril. The dorsal and pectoral spines are subequal.

In both forms the length of the base of the dorsal fin is the same: subequal to the snout.

Both dorsal and pectoral spines are measured to the end of the bony portion, excluding the flexible membranous tip.

The table shows certain growth-changes. At about 170 mm. the sexes are distinguishable but immature; at 180 mm. onwards the specimens are ripe or nearly so.

For comparison with the new species described below, the following details, taken from the 75- and 115-mm. specimens, are given: distance between anterior nostrils $1\frac{1}{2}$ in distance between posterior nostrils; snout slightly longer than postocular part of head; distance between bases of anterior (inner) mental (or mandibular) barbels $1\frac{1}{2}$ in distance between posterior (outer) mental barbels, and equal to distance between anterior nostrils; distance between posterior mental barbels equal to distance between anterior margin of eye and posterior nostril. These details apply also to the larger specimens.

The caudal lobes tend to become blunter in large specimens, but the emargination is always greater than in the next species (fig. 23, *b*).

The mucus tubules on the head are more or less dendritic (fig. 23, *a*), *i.e.* each tubule opens by two or more pores.

Localities.—In addition to Boulenger's and Gilchrist and Thompson's records, Fowler describes a specimen from Bethlehem, O.F.S. (on a tributary of the Vaal River); the S. Afr. Mus. has Kannemeyer's specimen from the junction of the Orange and Caledon rivers,* and several specimens from Upington.

* Kannemeyer, Proc. 26/vi/95 in Trans. S. Afr. Philos. Soc., viii, p. xcvii, 1896.

J. L. B. Smith gives Natal as a locality. It might be thought, perhaps, that he was referring to Fowler's record which was published in a paper dealing with fishes "mostly from Natal and Zululand." But Smith gives 15 inches as the greatest recorded length; this is much greater than any actually published record (220 mm. G. and T.), and may be a misprint; Smith informs me (*in litt.* 21/5/41) that he has no specimens in his collection.

Dr. Kannemeyer explains that this species gets its name from its preference for rocky spots, as opposed to the mud-loving *Clarias*.*

Gephyroglanis sclateri.

	TL	L/H	H/E	S/E	I/E	I/d.a.n.	Pectoral Spine Serrations.	g.r.	Sex and Remarks.
Potchefstroom	75	3¾	5	2	1½	2	6–7	4+10	
,,	115	4	5½	2⅓	1¾	2⅓	9	4+12	
Kraai R. .	135	4	5½	2⅓	1⅘	2⅓	11		
Upington .	140	4	5½	2⅓	1⅘	2⅓	..	..	Di. 8.
Johannesburg	145	4	6	2½	1⅘	2⅓	12–13	5+13	
Upington .	165	4	6	2½	1⅘	2⅓	..	..	♀ immature.
Potchefstroom	175	4	6	2½	1⅘	2⅓	14–15	..	♂ ,,
Vaal R. .	185	4	6	2½	1⅘	2⅓	16	..	♂ ♀.
Upington .	200	4	6½	2¾	2	2⅓	16–17	5+14	♂ ♀.
,, .	210	4	7	3	2¼	2½	17	..	♂ ♀.
Kafue R. .	210	4	7	3	2⅓	2½	14	5+15	♀ ovig.
Upington .	215	4	7¼	3⅓	2⅓	2½	15	5+15	♀ ovig.
Potchefstroom	220	4	7⅓	3½	2⅓	2½	16–17	5+15	♂.
,,	230	4	7½	3½	2⅓	2½	16–17	5+16	♀ ovig.
Orange R. .	300	4	7½	3½	2⅓	2¾	18–19	6+16	♀ ovig.*

23 specimens. * Kannemeyer's specimen.

Gephyroglanis gilli n. sp.

Clanwilliam Catfish.

Fig. 23, *c–g*.

Closely allied to *sclateri* (D i. 7, caudal lobes obtuse, etc.), but distinguished by the following characters.

The caudal lobes are more obtuse and the notch much shallower in *gilli* than in *sclateri*; the middle caudal rays being a little longer than the depth of the caudal peduncle instead of subequal (*cf.* fig. 23, *b* and *d*). As in *sclateri*, the lower lobe is usually slightly larger than the upper lobe. At 32 and 38 mm. the caudal is truncate with rounded corners; at 43 mm. slightly emarginate.

* Kannemeyer, Proc. 26/vi/95 in Trans. S. Afr. Philos. Soc., viii, p. xcvii, 1896.

The composition of the anal fin is different: 2 or 3 spines, 2 simple rays, 10 or 11 branched rays (including the last one, which in the smaller specimens is simple): total number 14–16. The usual formula is 3.2.10 = 15 (contrast with *sclateri*: 4.2.12 = 18).

The head is relatively larger and the eye smaller in *gilli* (*cf.* the 73, 77, and 105 mm. specimens of *gilli* with the 75 and 115 mm. *sclateri* in the tables).

The length of the snout is subequal to the postocular part of head. The snout is broader in *gilli*: distance between the anterior nostrils subequal to that between the posterior nostrils.

The distance between anterior nostrils equals distance between bases of anterior mental barbels (as in *sclateri*), but this distance is *twice* in distance between bases of posterior mental barbels; the latter distance almost as long as distance from anterior margin of eye and tip of snout. The distance between anterior nostrils is almost twice in snout in *gilli*, but almost thrice in *sclateri* (*cf.* fig. 23, *a* and *c*). The mucus tubules on the head are all simple (fig. 23, *c*), each opening by a single pore.

On the basis of these differences the institution of a separate species for the Olifants River form is justified. As Boulenger named his species after the then Director of the South African Museum, so it is appropriate to name this n. sp. after the present Director, Dr. E. L. Gill.*

Locality.—Olifants River system, Clanwilliam Division: in an irrigation furrow off the Jan Diesel's River in Bosch Kloof, Clanwilliam (Sept. 1936, K. H. B. and C. W. T.); Boontjes River, Citrusdal (A. C. H., K. H. B., and C. W. T., April 1937); upper reaches of Olifants River at the farm "Keerom" and in a side tributary on the farm "Noordhoek" (K. H. B. and C. W. T., Feb. 1939).

The dorsal fin formula is normally D i. 7, counting only one spine, although there is the same short blunt bony process in front of it as in *sclateri*. There are two very feeble and inconspicuous denticles on the hind margin of the spine at 55 mm., and 4–5 at later stages (fig. 23, *f*, *g*).

In 4 specimens out of 27 there are only 6 dorsal rays: one 38 mm., one 43 mm., and two between 70 and 80 mm.

As in *sclateri*, there are two forms of dorsal fin (fig. 23, *f*, *g*), which are irrespective of age (and by analogy, probably irrespective of sex also). The length of the base of the fin is the same in both forms, subequal to the snout.

* Written before Dr. Gill's retirement in January 1942.

In high fins the dorsal spine and 1st ray are equal to the distance from hind margin of opercle to, respectively, anterior margin of eye (or midway between eye and posterior nostril), and to posterior nostril. In low fins the dorsal spine and 1st ray are equal to the distance from hind margin of opercle to, respectively, hind margin of eye and to midway between eye and posterior nostril.

As in *sclateri*, the dorsal spine is a little longer than the pectoral spine (measured as indicated above) in the high fin form, but in the low fin form the two spines are subequal.

The margin of the low fin is even, with fine scalloping between the rays; the margin of the high fin is uneven, ragged, the rays projecting more or less beyond the membrane.

Although there is a slight amount of variation, there is no difficulty in at once separating the high and low finned forms. In the extreme forms, if they came from different river-systems, this difference might almost be regarded as constituting a specific difference. In fact, however, the difference appears to be due to habitat. In the case of *sclateri* no details are available as to the particular habitat of any of the specimens. But the Clanwilliam specimens were all collected by myself and my assistant Mr. Thorne and the following correlation can be observed.

The first seven specimens, 43–88 mm. in length, were caught in September 1936 in an artificial furrow leading from a side tributary of the Jan Diesels River. The furrow was from 1–2 feet wide and about the same in depth, with muddy bottom, and margins overgrown with vegetation. The current was moderate, and would probably be fairly constant even after heavy rains, as most of the flood water would be carried by the natural stream. All these specimens have low, untorn dorsal fins.

Four specimens, 70–105 mm., were caught in April 1937 in the Boontjes River near Citrusdal (a tributary of the Olifants River). The Boontjes is from 10–20 feet wide in this section; the bottom is rocky and stony in some places, sandy and muddy in other places. The specimens were caught under the banks of a muddy bottom; but they may have come down from the stony parts; the stony parts were not closely examined, as we were working with a fine net, and at that time we were unaware of the habits of these fish. These four specimens have high ragged fins.

In February 1939 in the upper reaches of the Olifants River ("Keerom") we discovered that these fish were quite common under the stones and boulders near the margin of the river. We found

them in a similar habitat in a side stream ("Noordhoek"). All these (16 specimens were killed, from 32–95 mm. in length) have high ragged dorsal fins.

Thus it appears that the low untorn fin is correlated with a placid and muddy habitat; whereas the high ragged fin is correlated with a stony and more turbulent habitat.

Several specimens were brought alive to Cape Town in February 1939 and handed over to Mr. A. C. Harrison. The smaller ones soon became quite tame and fed openly on Enchytraeid worms, but the larger ones remained shy. All were maintained in good condition until July 1939, when all but the smallest one died; and the latter died six months later. We hoped that they would attain maturity and breed in captivity, but apparently there was something lacking in the diet, as they all became very thin, although otherwise perfectly healthy.

Gephyroglanis gilli.

TL	L/H	H/E	S/E	I/E	I/d.a.n.	Pectoral Spine Serration.	g.r.	Sex and Remarks.
32	$3\frac{1}{2}$	$5\frac{1}{4}$	2	$1\frac{3}{4}$	$1\frac{1}{2}$	5	3+10	Di. 7.
38	$3\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$	6	..	Di. 6.
43	$3\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{1}{2}$	4–5	..	Di. 6.
55	$3\frac{1}{2}$	$5\frac{3}{4}$	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{1}{2}$	6–8	..	Di. 7. 2 feeble dorsal spine serrations.
60	$3\frac{1}{2}$	6	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{1}{2}$	5–8		
65	$3\frac{1}{2}$	6	$2\frac{1}{3}$	2	$1\frac{1}{2}$	5–10		
70	$3\frac{1}{2}$	6	$2\frac{1}{3}$	2	$1\frac{1}{2}$	6–10 *	4+10	4 feeble serrations.
73	$3\frac{1}{2}$	$6\frac{1}{4}$	$2\frac{1}{2}$	2	$1\frac{1}{2}$	6–10		
77	$3\frac{1}{2}$	$6\frac{1}{3}$	$2\frac{1}{2}$	2	$1\frac{1}{2}$	7–10		
83	$3\frac{1}{2}$	$6\frac{1}{2}$	$2\frac{1}{2}$	2	$1\frac{1}{2}$	7–10		
88	$3\frac{1}{2}$	$6\frac{3}{4}$	$2\frac{3}{4}$	2	$1\frac{1}{2}$	7–10	4+11	
90	$3\frac{1}{2}$	7	3	2	$1\frac{1}{2}$	8–10 *	..	4–5 feeble serrations.
95	$3\frac{1}{2}$	7	3	2	$1\frac{1}{2}$	10 *		
105	$3\frac{1}{2}$	7	3	2	$1\frac{1}{2}$	10	4+11	Immature.

27 specimens.

* 11, 12, or even 13, owing to obvious duplication of one or two serrations.

Family GALAXIIDAE.

1906. Regan, Proc. Zool. Soc. Lond., 1905, ii, p. 363.
1915. Boulenger, *l.c.*, iii, p. 12.
1917. Gilchrist and Thompson, *l.c.*, p. 470.
1936. Scott, Pap. and Proc. Roy. Soc. Tasman. for 1935, p. 85.

1938. *Id., ibid.*, for 1937, p. 111 (statistics for *G. attenuatus*).

1941. *Id., ibid.*, for 1940, p. 55 (colour pattern phases in *G. truttaceus*).

In New Zealand these scaleless fishes are known as Minnow, Gudgeon, Mud-fish, Whitebait, or Inanga (and other Maori names) (W. J. Phillips, Bibliogr. N. Zeal. Fish., 1927, Fish Bull., No. 1, pp. 13, 14). As they are quite different from the true (European) Minnow, the use of this name is to be deprecated. Attempts are being made, therefore, to familiarise Cape anglers and the general public with the name "Galaxias" as a colloquial name, adding "mountain form" and "lake (vlei) form" respectively for *zebratus* and *punctifer*.

Various opinions have been expressed as to the bearing of the geographical distribution of *Galaxias* on the question of the former approximation of the southern land-masses (Günther, 1886; Weber, 1897; Boulenger, 1905; Regan, 1913 and 1914; Meek, 1916; Macfarlane, 1923). Up to the present the discussion has been based on the bare fact that *Galaxias* is found in certain countries; its distribution within each country, in relation to the topography and the geological history of the respective countries has not been studied. Whether *Galaxias* has arisen from a marine ancestor independently in each of the southern continents, or whether its presence in these countries is evidence of their former intimate connection, are questions outside the scope of this paper. For the present an analysis of the specific characters of the South African species, and comments on the present-day distribution will suffice.

Scott (1936, *l.c.*, p. 105) proposes the name *Agalaxis*, as a subgenus of *Galaxias*, for the South African species because they possess only 6 rays in the ventral (pelvic) fins instead of 7 as in typical *Galaxias* from Australasia and South America.

If the anatomy of the South African species had been better known, it is probable that Scott would have suggested full generic rank for *Agalaxis*. Although the teeth resemble those of typical *Galaxias* in being uniserial in the jaws (*v. infra*), the number of vertebrae is less than that of any other Galaxiid yet investigated. According to Regan (1906), W. J. Phillips (1926), and Scott (1936), the number of vertebrae in certain Australasian and South American species of *Galaxias* ranges between 52 and 64; Scott (1936) describes *Saxilaga anguilliformis* with 73 myomeres. In the opposite direction *Paragalaxias* (Scott, 1935, Pap. and Proc. Roy. Soc. Tasman. for 1934, p. 41) has only 44 vertebrae. The South African representative has even fewer, viz. 40 (occasionally 39 or 41).

In conjunction with the character of 6 ventral rays, this low number of vertebrae might be considered to justify generic rank. It seems, however, a pity to refrain from using the classical and euphonious name in order to adopt the (with all respect to Mr. Scott) less euphonious anagram.

Moreover, Stokell has recently shown (1940, Trans. Proc. Roy. Soc. N. Zeal., lxix, p. 422) that variation in the number of ventral rays occurs not only in a species but even in an individual, and therefore that the subgeneric divisions proposed by Scott cannot be maintained.

The dentition of typical *Galaxias* comprises (Regan, 1906) a single row on the lower jaw, on the premaxilla, and on the entopterygoid, and a double row on the tongue. An exactly similar dentition is found in the South African species. That is, on the assumption that, when a dentition is said to be uniserial, it means that only a single row of teeth is operative at a time; it does not exclude the presence of an inner, decumbent, row of replacing teeth.

When the head of a South African *Galaxias* is rendered transparent in a clearing reagent (*e.g.* parachlorophenol + chloralhydrate) all the rows of teeth, which ordinarily appear to be uniserial, are seen to have a series of replacers adjacent to them: on the inner side of the mandibular and premaxillary rows, on the outer side of the entopterygoid row, and on the outer side of each lingual row. A similar appearance as regards the mandibular and premaxillary series has been figured by Scott (*l.c.*, 1935, fig. 1) for *Paragalaxias*. Scott regards the dentition of *Paragalaxias* as biserial. I believe that this is an erroneous description, because if the process of clearing be watched under a lens, the row of replacer teeth only becomes visible as the flesh becomes transparent, whereas the operative row is visible without any clearing.

Scott (1935, *l.c.*, p. 43, fig. 2) in a brief mention of the mucus-pits or pores in *Paragalaxias*, says there are 6 on the dorsal surface of the head. The figure shows 2 interorbital pairs and a single postorbital pore behind each eye. In case the number and arrangement of the pores varies in different genera or species, the arrangement in the South African species may be given. In addition to the 6 in the same position as in *Paragalaxias*, there is one on the inner side of each posterior nostril, and one on the inner side of each anterior nostril. On the side of the head there is one behind each anterior nostril, 2 preorbital, 1 suborbital, and 5 around the edge of the preopercle. Below, and slightly in front of the suborbital pore,

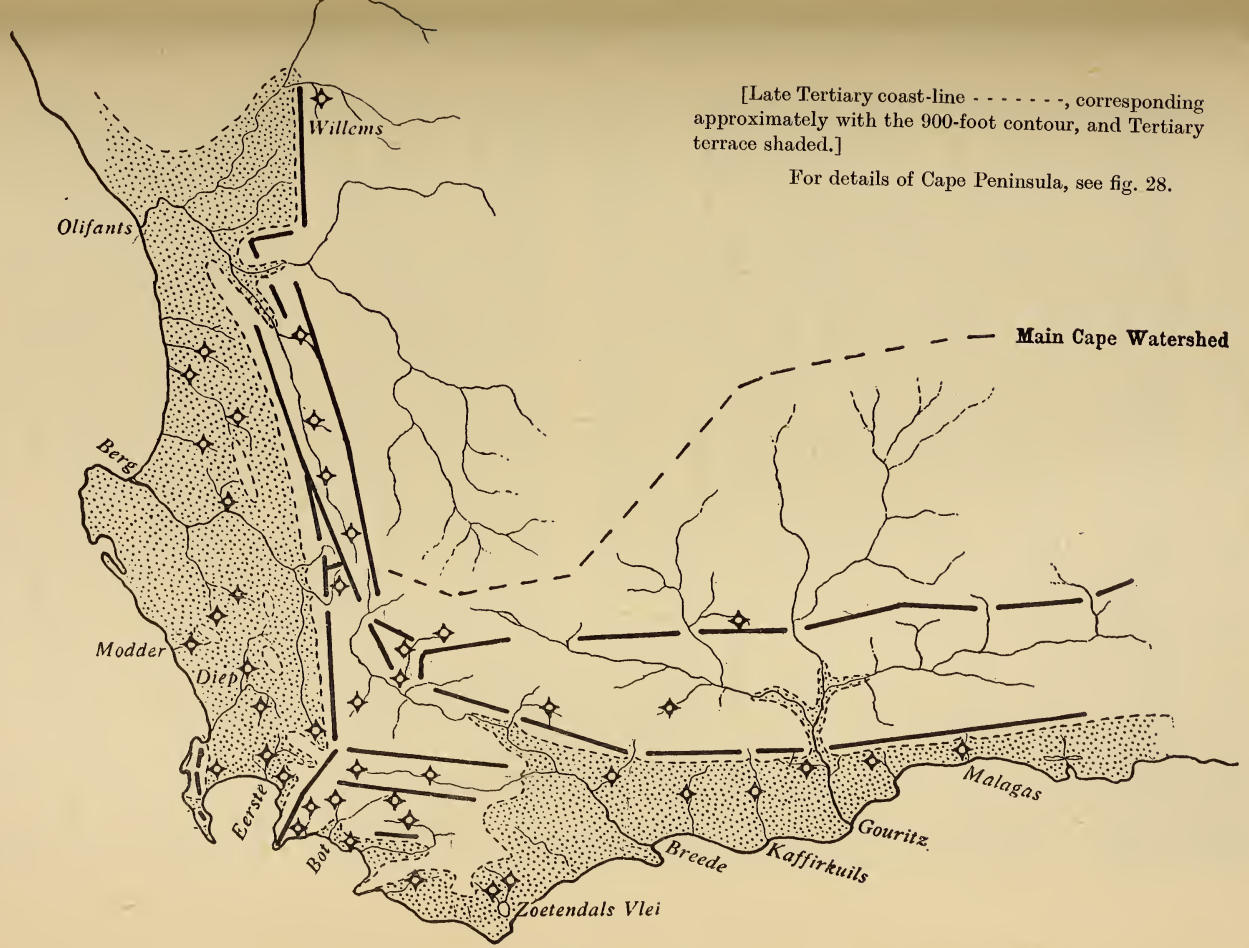


Fig. 24.—Distribution of *Galaxias*.

there may be another, small and indistinct, but often absent (fig. 25).

The lateral line pores are somewhat irregular, there being sometimes two, though usually only one, to a myomere. The number of pores is therefore not an indication of the number of myomeres (vertebrae).

The arrangement in both forms, *zebratus* and *punctifer*, is the same.

The following would appear to be characteristic of the South African species: vertebrae (39) 40 (41); teeth on jaws and entopterygoid uniserial, a double row (larger and recurved) on the tongue; branchiostegals (6) 7; gill-rakers on anterior arch 2 or 3 + 9 or 10; D 3–4, 8–9; A 3–4, 8–10 (total in both cases 11–13).

As regards the species in South Africa, Gilchrist and Thompson admitted three in their monograph, but suggested (p. 473) that the examination of extensive material might show that the three species should be regarded as varieties of one. Such examination does indeed lead to the conclusion that *dubius* G. and T. cannot be maintained as separate from *zebratus*, and furthermore that Castelnau's original two species are variable to such an extent that only their extreme forms can be separated.

Both of Castelnau's species were found together on the Cape Flats, near Cape Town, *punctifer* being stated to be "beaucoup plus rare" than *zebratus*.

Steindachner's species *capensis* has been regarded as synonymous with *zebratus* (Regan, Boulenger, Gilchrist and Thompson), and specimens from the same locality, Lourens (Lorenz) River, Somerset West, in the South African Museum confirm this synonymy.

The examination and tabulation of the characters of some 4700 specimens of all sizes (9 mm. upwards), mostly long series from each of several localities, discloses the extreme difficulty of finding clear-cut and constant characters of specific value.

Ratios of head-length to body-length, depth to length of caudal peduncle, length of the latter in relation to head-length, etc., are quite inconclusive in a long series. The positions of the dorsal, anal, and ventral fins, and even the most outstanding difference, namely, the shape of the caudal fin, are found to be variable, and the extreme forms, *zebratus* and *punctifer*, are connected by transitional forms (fig. 26). Young and half-grown examples often have a squarish tail and approximate closely to typical *punctifer* in this respect. See also Steindachner's description of *capensis* (SB. Ak. Wiss. Wien, ciii, p. 460, 1894), where variation in the position of the dorsal fin and shape of the tail is noted.

Castelnau's statement that *punctifer* was much rarer than *zebratus* is certainly true, taking the S.W. Cape as a whole. The only recorded localities for *punctifer* are: "Cape Flats" (Castelnau), Liesbeek River, at Durban Road (Regan), and Diep River, Lakeside (Gilchrist and Thompson). Recently, however, typical examples have been collected

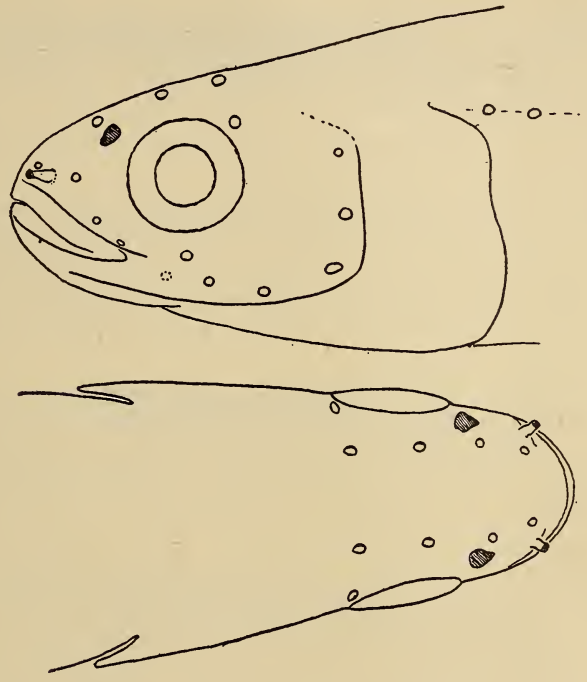


Fig. 25.—*Galaxias.* Lateral and dorsal views of head, showing mucus pores; only two in lateral line in upper figure shown. Openings of nostrils shaded.

in the Mosselbank and Diep * rivers (Klipheuvel–Philadelphia–Kalabas Kraal, Malmesbury area); in the headwaters of the Zout River, a tributary of the Gt. Berg River, near Mamre Road Siding; in Zeekoe Vlei on the Cape Flats; and near the mouth of Verloren Vlei, Piquetberg Division.

All these examples are (after preservation in alcohol) cream-coloured, with scarcely any trace of pigmentation. When alive they were transparent, the backbone, the red gills and heart, and the

* Not to be confused with the previously mentioned Diep River. See p. 119.

silvery lining of the body cavity showing through. The water in the Mosselbank and Diep rivers at the time was muddy and opaque; that in Zeekoe Vlei clear, with a pale sandy bottom; in the latter habitat the fishes whenever possible sought shelter under the landing-stage, boats, or clumps of weed growing on the bottom.

Other series collected in the Nieuwejaars River, Elim, and in a small stream at Strandfontein (S.E. of Zeekoe Vlei on the False Bay coast) approach very closely to typical *punctifer*, but tend to be more pigmented, and the caudal fin can be described as emarginate *only when not completely expanded.*

The only factor which appears to be common to these localities is a slight alkalinity of the water: pH 8–9.

Passing to the other extreme, the *zebratus* form, with a more or less rounded tail, and (usually) a heavier, often a much heavier, pigmentation, we find this in the smaller streams, nearer the foot of the mountains, where there is usually an abundance of decaying vegetable debris, and the water is more or less brownish ("peat"-stained) and on the acid side: pH 5–6·5.*

But variation occurs in each and every locality. Some of the Mosselbank River, Mamre Road Siding, and Zeekoe Vlei specimens have very feebly emarginate or square tails, with the tips of the lobes very slightly rounded. Amongst the Strandfontein lot was one with a very definitely and conspicuously rounded tail. Young and half-grown specimens, as already remarked, are often impossible to place in the one or the other form, judging by the shape of the tail.

Therefore, as a series showing complete transition from the *zebratus* form to the *punctifer* form could be picked out, though not from a single community in any one locality, only one species (*zebratus*) should be recognized. But the extreme forms, if placed side by side, are so distinct that this course would probably not meet with general approval. We may therefore recognize two forms, thus:

zebratus.—Caudal fin rounded-truncate, the tips of the lobes usually distinctly rounded, but sometimes somewhat squarish; distance between end of middle caudal rays and 1st dorsal spine (not the adipose extension in front of it) not exceeding the distance between latter and hind margin of eye, *i.e.* the 1st dorsal spine arises slightly behind the middle of the *total* length, and approximately opposite the vent; usually more or less heavily pigmented, with or

* Colour of the water and acidity are not necessarily correlated. In the lower reaches of the Nieuwjaar River near Zoetendals Vlei the water is alkaline but retains its brown-stained coloration (A. C. H.).

without cross-bars, the silvery lining of the belly mostly obscured; usually in slightly acid waters.

punctifer.—Caudal fin emarginate, the tips of the lobes square or slightly acute; distance between end of middle caudal rays and 1st dorsal spine subequal to (or even slightly greater than) distance

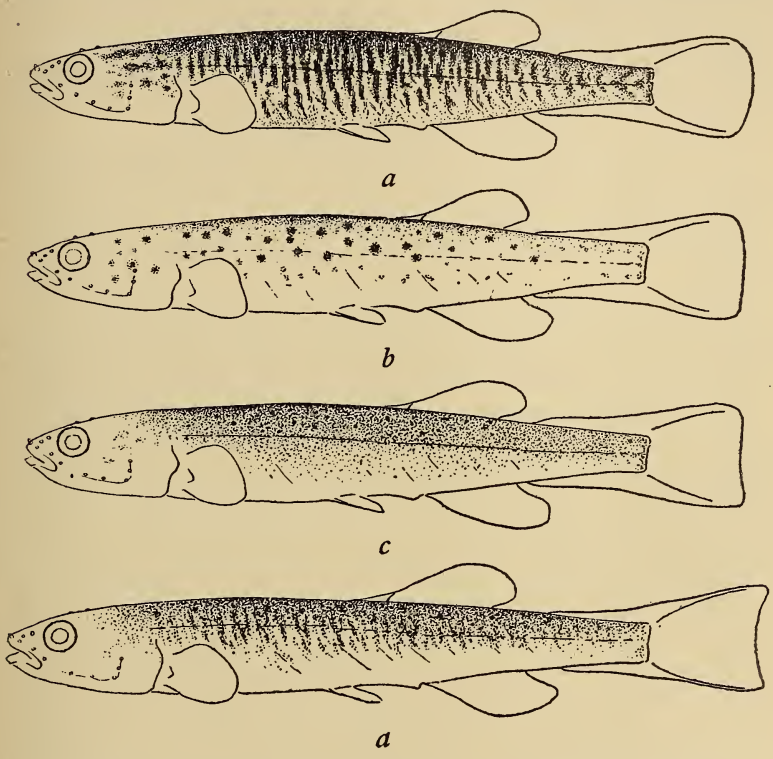


Fig. 26.—*Galaxias*. Semidiagrammatic, to show variation in caudal fin in *zebratus* (*a–c*) and *punctifer* (*d*). The letters *a–d* are each exactly at the middle of the total length. Varieties of coloration also shown, but there is no correlation between coloration and morphology.

between latter and tip of snout, *i.e.* 1st dorsal spine arises in middle of total length, and slightly in advance of vent; body often a little more slender, especially the caudal peduncle; usually scarcely or not at all pigmented; the silvery lining of the belly usually very distinct; usually in slightly alkaline waters.

Fig. 26 shows typical *zebratus* and *punctifer* and two transitional forms. It may be noted that Boulenger's fig. 8 of *zebratus* is rather

too deep in the body, and that the outline of the dorsal fin in Regan's fig. 3 of *punctifer* is not quite accurate (both figures copied in Gilchrist and Thompson's work).

Coloration.—Fig. 26 also shows some of the varieties of coloration, but is not intended to indicate any correlation between coloration and morphology. There is no such correlation. Typical *zebratus* is more or less strongly barred (*a*). The most heavily barred specimens are found in the Silvermine Stream, Kalk Bay, Cape Peninsula, many of them being even more heavily barred than the one figured, the dark bars extending almost to the ventral profile.

In other examples, and in other localities, a mild barring (*d*) or a shadowy mottling is found, or the whole body is tinted with minute specks with here and there a larger dot (*c*).

Both the *c* and *d* coloration, but mostly the former, is found in *punctifer*.

Adult males of the *zebratus* form are usually darker in colour than females, either the cross-bars being more intense, or the pigmentation (*c*) becoming so dark and uniform that all markings are obliterated.

The character of the stream-bed and the colour of the water may perhaps influence the coloration. Most of the habitats are small streams (not the main rivers) with muddy (fine, dark, vegetable debris) bottoms, or containing pools with muddy bottoms, with more or less brown-coloured water. But in one such stream, the Jan Niemands, a tributary of the Palmiet River, all the *Galaxias* were noticeably pale. In some clear streams with gravelly or stony bottoms, the gravel and stones being various shades of grey, buff, or orange-brown, specimens of a pale buff or grey body-colour were found, with either a uniform and faint pigmentation (*c*) or irregularly arranged dark spots (*b*). The figured specimen of *b* is by no means the most heavily spotted; these spotted specimens are very striking, especially after preservation, as the body-colour fades to white while the spots remain (in alcohol) for a considerable time. The colour of typical *punctifer* has been noted above.

Whether colour changes could be induced in captivity would be an interesting experiment; as would also experiments to show whether the extreme forms of *zebratus* and *punctifer* will interbreed.

Breeding.—Except that they are not sea-going, little is known about the breeding of South African *Galaxias*. They are hardy in captivity, but in spite of continual observation (examples in glass tanks) (A. C. H.) the actual pairing and deposition of the eggs has not been seen.

The ripe eggs are demersal, relatively large, numbering about 30–40; the number probably seldom if ever exceeds 50.

The fishes become sexually mature at about 38–40 mm. in length. The maximum length seems to vary in different localities: on the Cape Peninsula both the *zebratus* and *punctifer* forms reach a length of 65 mm. The largest specimen of *zebratus* hitherto caught is one of 68 mm. (Slanghoek stream, Worcester district), and the largest *punctifer* one of 75 mm. (Malmesbury). The specimens collected by Dr. Holub in 1884 at Somerset West and described by Steindachner (1894) as *capensis* were "nearly 7 cm." in length.

Very young fry have been observed in captivity in garden ponds during March (A. C. H.), and have been collected in the free state in June, July, August, and September (Cape Peninsula), late September and October (Clanwilliam and Villiersdorp), November (Citrusdal and Hermanus), January (Genadendal), February (Drakenstein, Cape Peninsula, and George), April (Hermanus). In most cases mature specimens (the ♀♀ with ripe eggs) were taken at the same time. Probably breeding occurs throughout the greater part of the year.

Individuals have been kept in captivity for three years (A. C. H.).

Postembryonal Stages.—The earliest stage yet obtained is one 9 mm. in length (fig. 27, *a*) showing the straight tail, and no indications of the fins (except the pectorals). At 10·5–11 mm. there appear the indications of the dorsal fin, and, at a slightly later stage, of the anal fin; and the tail has an upward bend (heterocercal). At 12·5–13 mm. in this series, corresponding with a stage slightly later than the 11-mm. stage in the George series (fig. 27, *b*), the dorsal fin is nearly free of the median adipose flange or lamina of skin, and the ventral fins are just visible as two minute knobs. At 15 mm. the ventral fins are free, but the anal is still embraced within the median flange. At 16–17 mm., corresponding with the 15-mm. stage in the George series (fig. 27, *c*), both the medio-dorsal and medio-ventral flanges have disappeared except for a short extent on the belly and on the caudal peduncle. The belly flange persists until the fish is about 18–19 mm. in length. On the caudal peduncle the flange is gradually reduced to a greater or lesser extent (fig. 26).

Distribution (figs. 24 and 28).—The known limits of distribution to the north and east have not been extended since Gilchrist and Thompson wrote, but *Galaxias* has been shown to occur in many intervening localities. The northward limit is the Willems River (Gilchrist and Thompson) about 6 miles north of Nieuwoudtville (Calvinia Division), which flows northwards into the Klein Doorn

River, Zout River, and thence into the Olifants River. In the same river-system *Galaxias* occurs in the Boontjes River (Citrusdal) and Jan Diesels River (Clanwilliam), and in the headwaters and upper reaches of the Olifants itself.

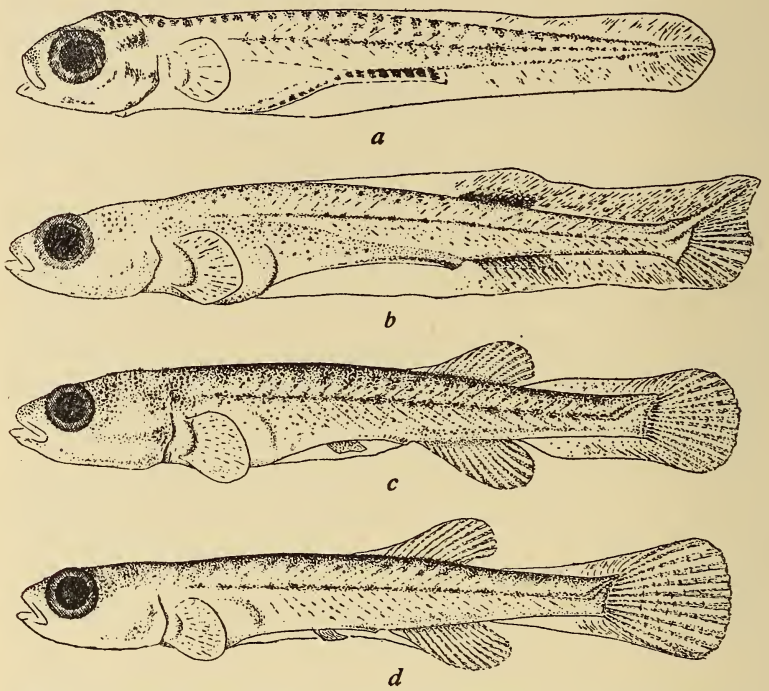


FIG. 27.—*Galaxias*, juveniles. *a*. 9 mm. (Villiersdorp). *b*. 11 mm. (George). *c*. 15 mm. (George). *d*. 13 mm. (Lourens River, Somerset West).

Galaxias is probably to be found in all streams near the bases of the mountains (not in torrential mountain streams), and side channels of the rivers in the following systems, and in the neighbouring vleis (lakes) if permanent. The following are actual localities (where no author is added, collected by S. African Museum or A. C. Harrison):—

zebratus (mountain form)

Olifants River, Clanwilliam: headwaters of main river (so-called Malangs River) between Witzenberg and Schurfteberg Ranges; main river at Keerom (P.O. Groot Kuil); Boontjes River, Citrusdal; Jan Diesels River in Bosch Kloof, Clanwilliam; Willems River, north of Nieuwoudtville (Gilchrist and Thompson).

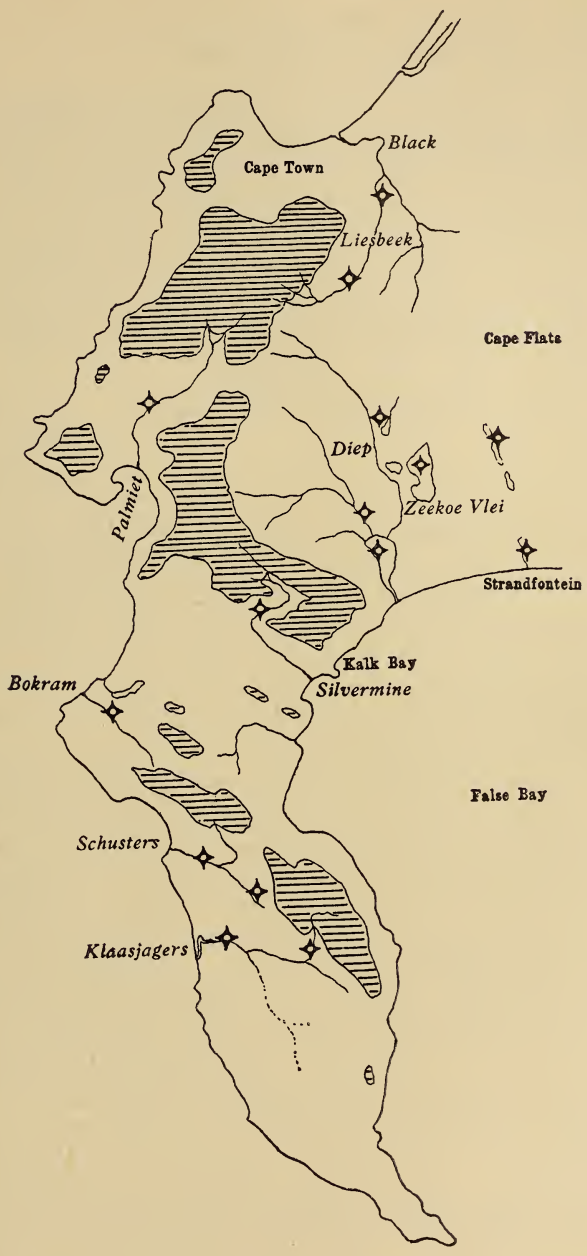


Fig. 28.—Map of Cape Peninsula, showing localities for *Galaxias* (*zebratus* and *punctifer*). Land above 900-foot contour shaded.

Langevlei, Leipoldtville (Clanwilliam Division).

Het Kruis, upper reaches of Verloren Vlei.

Zoutkloofs River, north-west of Aurora.

Berg River: headwaters of Little Berg River at Tulbagh; of the Berg River at French Hoek (Weber), Wemmershoek, and Drakenstein; Bushmans River at Sauer (transition to *punctifer*).

Modder River, west of Mamre (Malmesbury Division).

Cape Peninsula: Liesbeek River at Newlands (Weber), at Kirstenbosch and Rondebosch; Little Princess Vlei (Weber); Silvermine stream, Kalk Bay; Palmiet River flowing into Hout Bay; Bokram stream, Kommetje; Schusters and Klaasjagers rivers. "Cape Flats" (Castelnau).

Eerste River: Jonkershoek, Stellenbosch.

Lourens River, Somerset West (Steindachner, Gilchrist and Thompson).

Steenbras and Palmiet rivers; and Malkop Vlei on west side of Palmiet River mouth (property of Hangklip Estates) (A. C. H.).

Bot River: a small tributary at Eerste Hoop (Post Office) on Bot River to Viliersdorp road; Zwart River at Caledon.

Onrust River, and small streams on coastal terrace near Hermanus.

Hartebeest River, being the upper reaches of the Klein River.

Zontagskloof stream.

Nieuwejaars River, Elim (transition to *punctifer*); Grashoek and Kars rivers, Bredasdorp district.

Breede River tributaries: Montagu; Zanddrift and Buffelshoek streams, Hex River; headwaters of Zanddrift stream north of Matroosberg (farm "Lakenvlei," Ceres district); du Toit's Kloof, Rawsonville; Slanghoek, Goudini; Zonder End River, headwaters near French Hoek Pass (east side) and Villiersdorp, and Genadendal; Buffelsjagt River, east of Swellendam.

Gouritz River system: Klein Zwartberg stream, tributary of the Buffels River, north of the Zwartberg Range (near farm "Koudebergs Berg"); Seven Weeks Poort stream east of Ladismith; Weyders River, south of the Langeberg Range, Albertinia Division; Doorn River, Barrydale.

Little Brak River (Mossel Bay district); upper reaches at Haalkraal.

Malagas River, George district (Gilchrist and Thompson, also recent collecting); Wit Els River, George district.

punctifer (lake or vlei form).

Verloren Vlei, near mouth.

Berg River: stream crossing Malmesbury to Hopefield Road; Zout River at Mamre Road Siding; Bushmans River at Sauer (transition to *zebratus*).

Diep River and its tributary Mosselbank River, Klipheuvel, Kalabas Kraal, and Malmesbury districts.

Cape Peninsula: Liesbeek River at Durban Road (Regan); Diep River at Lakeside (Gilchrist and Thompson); "Cape Flats" (Castelnau); Princess Vlei; Zeekoe Vlei; Oleboom Vlei (A. C. H.); Strandfontein.

Eerste River: below junction with Kuils River, Faure (Sheik Joseph's Tomb).

Nieuwejaars River, Elim (transition to *zebratus*).

All these localities lie on the Tertiary marine-cut terrace, or on the present-day headwaters of rivers flowing across it. This terrace follows approximately the 900-foot contour (fig. 24).

In the map of the Cape Peninsula the land above the present 900-foot contour is shaded (fig. 28). Only in these areas is the water-table apparently high enough to maintain a perennial stream. Towards the end of summer the Bokram, Schusters, and Klaasjagers streams run very low, becoming often merely a series of disconnected pools or bog-holes; and the water becomes brackish. At such times, near the mouth of the Klaasjagers River, *Galaxias* occurs in water as salt as the sea. This fact is not surprising when we remember that *G. attenuatus*, the Australasian and S. American species, migrates downstream to the coast for spawning.

Although it is not intended to draw any conclusions here, the distribution of *Galaxias* in the S.W. Cape is certainly very suggestive of a marine ancestry during the Tertiary epoch, followed by the adoption of a fluviatile habitat, and gradual penetration inland with the cutting-back of the streams.

Some experiments on the duration of survival out of water were made by Mr. A. C. Harrison, on lines similar to those of Scott (1938, Pap. Proc. Roy. Soc. Tasmania for 1937, p. 138). Using *G. zebratus*, it was found that the fishes when placed in a dry enamel bowl became very adhesive as they dried, and this probably acted against their survival, especially in the case of small and weak fishes. In this experiment the fishes survived only 3–6 hours. Others were then

placed on very slightly damp moss, and in these conditions survived 10 hours (the experiment was not completed owing to an accident).

Family ANABANTIDAE.

1909. Regan, Proc. Zool. Soc. Lond., ii, p. 770.

Up to the present no species of this family has been recorded from any of the Cape rivers north of the main Cape watershed, nor from the Orange Free State, Transvaal, Natal, and southern part of Portuguese East Africa. Hey makes no mention of Kurper from the Transkei, Pondoland, or Natal.*

From Lake Ngami and the Zambezi basin northwards occur several species with more or less multispinose opercle and denticulate subopercle (*Ctenopoma*), allied to the Indian and S.E. Asiatic species (*Anabas*).

The two Cape species have a non-denticulate subopercle, and the opercular spines either entire or feebly bifid or trifid.

Both the morphology and the remarkable discontinuity in distribution therefore uphold the justice of Regan's classification, which regards the Asiatic *Anabas*, the tropical African *Ctenopoma*, and the Cape *Sandelia* (*olim Spirobranchus*) as three separate genera.

In addition to the character of the opercle, there are the following differences between *Ctenopoma multispinis* and *Sandelia capensis*.

All the scales in *multispinis* (except those forming the sheaths of the dorsal and anal fins, those on top of head and on throat) are ctenoid; in *capensis* all or very nearly all of them are cycloid.

In *multispinis* the anterior prolongations of the air-bladder are relatively short, ending close behind the rather deep posterior cavity of the supra-branchial chamber (fig. 30, *a*); in *capensis* they are very long, extending up towards the nape, where they are separated one from the other by the vertical septum of the supra-occipital bone at the back of the skull (fig. 30, *b*). In neither species is there any apparent connection between these anterior prolongations of the air-bladder and the supra-branchial chamber. In juvenile *capensis*, 13 mm. total length, the anterior prolongations are already developed to their full extent, whereas the posterior prolongations extend only half-way along the anal fin (in the adult they extend to midway on the caudal peduncle).

The labyrinthine organ is very simple in *capensis* (fig. 30, *b*; and *cf.* Cuv. and Val., Hist. Nat. Poiss., pl. 205), but complexly foliate

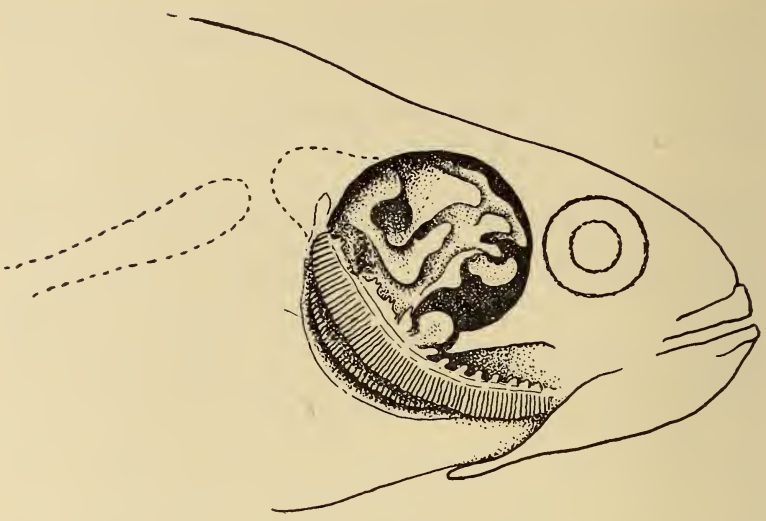
* See p. 120. "Kurper" in the Transvaal refers to species of *Tilapia*.

in *multispinis* (fig. 30, *a*). In adult *capensis* there is a more or less horizontal lamina arising from the upper part of the rachis of the 1st gill-arch, fused with the hind wall and forming the lining of the upper posterior half of the chamber, and extending across to the inner (median) wall of the chamber; thus incompletely dividing the

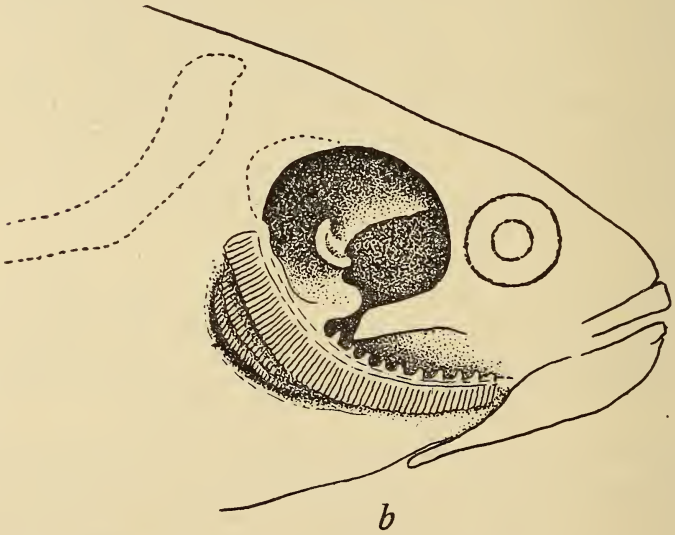
Fig. 29.—Distribution of *Anabantidae*. ▲ Tropical forms with denticulate subopercle and more or less multispinose opercle (*Ctenopoma*). ● Southern forms with non-denticulate subopercle, and only two entire (or feebly bifid) opercular spines (*Sandelia*).

chamber into an upper and a lower cavity. The free margin of this lamina is sinuous, more or less thickened, and often develops a small ear-like lobe (usually not so large as that represented in the figure). In juveniles of 17 mm. total length the lamina is relatively small, and arises on the rachis between the inner and outer rows of gill-rakers. At 25 mm. total length the base of the lamina seems to have spread outwards so as to absorb the 2 uppermost outer gill-rakers, all trace of which has vanished.

In *multispinis* there is a similar lamina continuous with the upper



a



b

Fig. 30.—Dissected head to show 1st gill arch with labyrinthine organ (adults). Posterior cavity of the branchial chamber, and position of anterior prolongation of the air-bladder indicated by dotted lines.
a. Ctenopoma multispinis. *b. Sandelia capensis.*

part of the gill-arch and extending across the branchial chamber as in *capensis*, but additional lobes and foliations are developed from its free margin and outer surface. There are traces of 4 (or 5) upper outer gill-rakers. Further, there is a small ear-like lobe anterior to the main foliate lamina, and seemingly formed by expansion of one of the outer gill-rakers.

In *Anabas* (*sensu stricto*) the supra-branchial chambers extend upwards into the cavity behind the head and are separated by the supra-occipital septum, but Regan (*l.c.*, p. 770) does not mention the extent of the anterior processes of the air-bladder.

In some MSS. notes made by the late W. W. Thompson in preparation for Gilchrist and Thompson's Monograph, I find that Thompson had observed these differences and wanted to use them as a reason for separating the three genera. Apparently he was overruled in deference to Boulenger.

Breeding.—I have not seen Boulenger's paper on oral gestation in *A. multispinis* (The Field, cxviii, p. 968, 1911), nor a paper on the breeding of *Anabas* by Lönnberg (Fauna och Flora, Upsala, vi, p. 224, 1911).

Gen. Sandelia Cast.

1829. Cuvier, Règne Anim., ed. 2, ii, p. 229 (*Spirobranchus*, preocc. Oken, 1818, Vermes).

1831. Cuvier and Valenciennes, Hist. Nat. Poiss., vii, p. 392 (*Spirobranchus*).

1861. Castelnau, Mem. Poiss. l'Afr. austr., p. 36.

1909. Regan, *l.c.*, p. 770 (*Spirobranchus*).

1916. Boulenger, *l.c.*, iv, p. 48 (*Anabas*, part.).

1917. Gilchrist and Thompson, *l.c.*, p. 542 (*Anabas*, part.).

Sandelia capensis (C. and V.)

Cape Kurper.

Figs. 30, *b*, 31, 32.

1916. Boulenger, *l.c.*, iv, p. 50, fig. 27.

1916. *Id.*, *ibid.*, p. 51, fig. 28 (*vicinus*).

1917. Gilchrist and Thompson, *l.c.*, p. 543, fig. 157.

1917. *Id.*, *ibid.*, p. 545, fig. 158 (*vicinus*).

Examination of a large amount of material, including series of specimens of all sizes caught at one and the same time and place, convinces me that *vicinus* cannot be maintained as a separate species; but it may well rank as a colour variety.

In specimens from the S.W. Cape the dorsal spines vary from 12 to 14, the anal spines from 6 to 8, the usual numbers being 13 and 7 respectively. In specimens from localities farther east, George to Port Elizabeth, the anal spines number 8, only occasionally 7, and the dorsal spines vary from 13–14, mostly 14 (one specimen with 15).

The slight difference in size between the scales on the upper part of the body and those in the middle of the side is often a little more noticeable in *vicinus* than in typical *capensis*.

The number of scales around the caudal peduncle (at its base) is normally 18, but there may be only 16, especially in younger specimens (30–60 mm.), or 14 (15–25 mm.).

The opercular spines are more or less obtuse; when the covering skin is removed, they are seen to be frequently feebly bifid or sometimes trifid, the points being separated merely by a slit or very narrow cleft; often the composite nature of the spine is shown only by surface striae or slight ridges.

The coloration and markings are not always stronger or more distinct in the *vicinus* form than in the *capensis* form; as Castelnau remarked, there is considerable variation in colour. Specimens from muddy and opaque water in the Diep and Mosselbank rivers (Malmesbury–Kalabas Kraal–Klipheuvel district) were silvery with a very pale greenish tinge, even the opercular spot being inconspicuous. Sometimes there is a pinkish tinge around the axil of the pectoral fin. Hence the name "Rooivlerk Kurper" applied in some localities (see pp. 107, 120).

The largest specimen I have seen is one 215 mm. in length from Princess Vlei, Cape Flats; this specimen contained 2 full-sized *Gilchristella*, and pieces of water-weed (the latter possibly accidental). Juveniles from 8 mm. upwards have been examined.

These juveniles were taken in November, December, and January, but it is not known how long the spawning season lasts. Males appear to begin breeding at 70 mm., females at 80 mm.

Some rather noticeable differences in body-shape have come under observation.

The original figure by Cuvier and Valenciennes (reproduced in Boulenger and G. and T.) is a fair representation of the normal shape of a small or medium-sized specimen, though the body is usually a little deeper. In most cases the depth of the body is about equal to length of head, $2\frac{3}{5}$–$2\frac{4}{5}$ in length (to end of *large* scales on caudal peduncle); the depth between anal spines and dorsal fin is less than

length of head. The front profile is very slightly convex, and the snout is moderately sharply pointed (fig. 31, *a*).

Large specimens from Aurora (Piquetberg Division) and Cape Flats tend to become "bull-nosed," with bluntly rounded snout (fig. 31, *e*).

Specimens from the Diep River in the Malmesbury district are unusually shallow: the depth less than length of head, and $3\frac{1}{2}$ times in length of body (fig. 31, *d*).

In the opposite direction there are specimens, *e.g.* from Goukama River near Knysna, showing an increase in the depth of the body, the depth being greater than length of head, and $2\frac{1}{2}$ times in length of body (fig. 31, *b*).

The most remarkable specimen observed is one from the Palmiet River, Elgin, which was forwarded to Mr. A. C. Harrison (Inland Fisheries Advisory Officer) as a "Black-bass" (which has been introduced into this river). The body is very deep, the depth being only $2\frac{1}{3}$ times in body-length, and considerably greater than length of head. The dorsal-anal depth also is greater than length of head. The profile is slightly but distinctly concave, and the snout is abnormally sharp (fig. 31, *c*). The colour was also abnormally dark.

A thoroughly intensive study of large numbers of specimens from all rivers and localities has not been carried out, but the following points may be noted, not as demonstrated facts but as indicating lines of investigation.

There seems to be a tendency in large specimens to become "bull-nosed," and this may be found to be more noticeable in specimens from alkaline waters (pH 7·5–8·5) and to be correlated with a lesser body-depth. On the other hand, in the specimens from acid waters (pH 4·5–5·5) the depth seems to be greater and the snout more pointed. As examples of this are 2 from Goukama River near Knysna, and the extreme form from the Palmiet River.

The extremes of the shallow and deep forms placed side by side, and apart from the intermediates, appear to be utterly different species.

In addition to the localities given in Weber, Boulenger, Gilchrist and Thompson, recent collecting has supplied specimens from the following localities (arranged from north to south and then eastwards):—

Langevlei River, Leipoldtville (Clanwilliam Division).
Het Kruis and Verloren Vlei (Piquetberg Division).
Zoutkloofs River, N.W. of Aurora (Piquetberg Division).

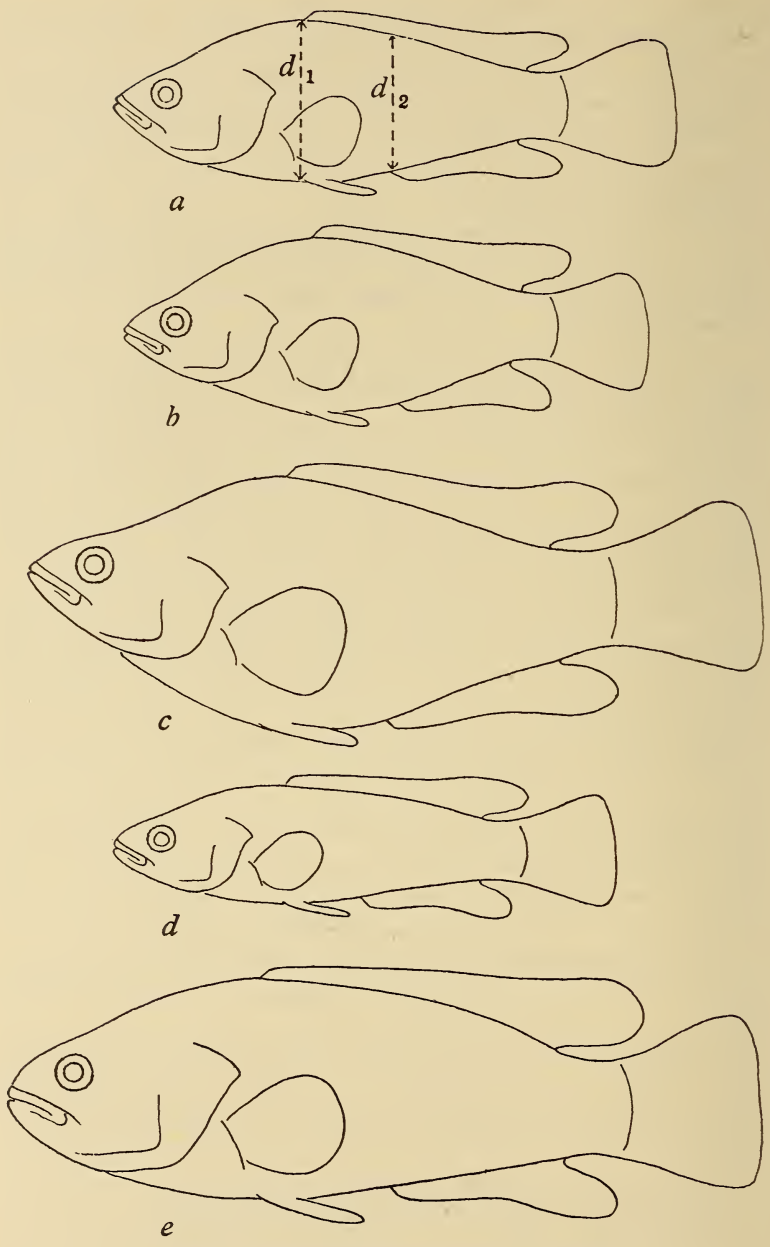


FIG. 31.—*Sandelia capensis*, variation in shape.

Berg River: Twenty-four Rivers (south of Porterville); Drakenstein.

Diep and Mosselbank rivers near Philadelphia, Kalabas Kraal, Klipheuvel, and Malmesbury.

Cape Peninsula: Liesbeek stream, and Diep River, Lakeside.

Eerste River.*

Steenbras and Palmiet rivers.

Bot River: at Eerste Hoop and Houw Hoek Pass.

Onrust River, Hartebeest, and Klein River (Hermanus–Stanford district).

Zonntagskloof and Uilenkraal rivers.

Nieuwejaar River, Elim; Grashoek and Kars River, Bredasdorp district. Also Zoetendals Vlei (coll. V. Fitzsimons, Transvaal Mus.).

Breede River and tributaries: Witte River (Bain's Kloof); Robertson; Hex River, Worcester; headwaters of River Zonder End (east side of French Hoek Pass); Villiersdorp; Genadendal; Buffelsjagt River (east of Swellendam).

Duivenhoks River, Heidelberg (Cape), and Kaffirkuils River, Riversdale.

Gouritz River: Touws River between Ladismith and Montagu; Buffels River west of Ladismith; Seven Weeks Poort, Amalienstein; Langtouw River, Herbertsdale; Weyders River, Albertina district.

Ruigte Vlei, between George and Knysna.

Goukama River, near Knysna.

Keurbooms River at Edmonton.

Kromme River, Assegai Bush.

* Hey (*l.c.*, Rep. i, p. 36, 1926) stated that the Kurper had been exterminated in the Eerste River, but that is incorrect.

---

a. Palmiet River. pH 4·5–5, 100 mm., typical, $\frac{l}{d_1}$ $2\frac{4}{5}$, $d_1 = h$, $d_2 < h$.

b. Goukama River. pH 5, 95 mm., rather deep, $\frac{l}{d_1}$ $2\frac{1}{2}$, $d_1 > h$, $d_2 = h$.

c. Palmiet River. pH 4·5–5, 130 mm., very deep, $\frac{l}{d_1}$ $2\frac{1}{3}$, d_1 and d_2 both $> h$.

d. Diep River, Malmesbury district. pH 8–8·5, 90 mm., very shallow, $\frac{l}{d_1}$ $3\frac{1}{2}$, d_1 and d_2 both $< h$.

e. Aurora, Piquetberg Division. pH 7·5, 135 mm., shallow, bull-nosed, $\frac{l}{d_1}$ $2\frac{3}{4}$, $d_1 = h$, $d_2 < h$.

Zeekoe River, Humansdorp.

Gamtoos River (lower portion) at Loerie and Patentie. In the Groote River at Fullarton and Steytlerville, *i.e.* the upper portion of the Gamtoos River, no specimens were obtained.

Van Stadens River.

Zwartkops River, Uitenhage.

The distribution, though extending farther eastwards, is thus the same as that of *Galaxias*, viz. all along the old Tertiary terrace and

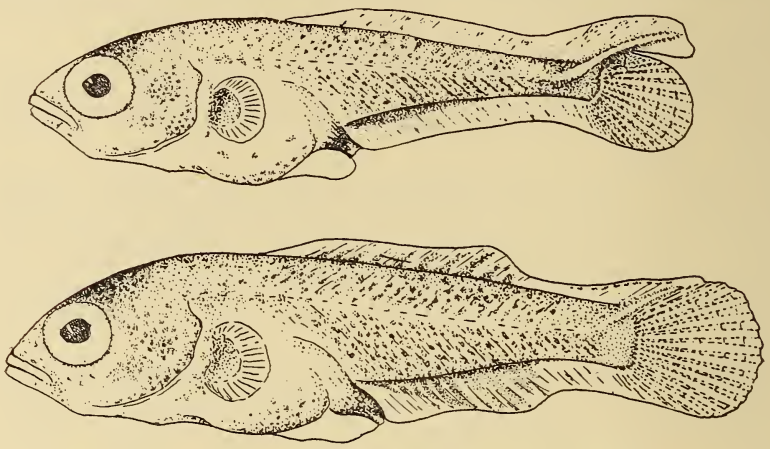


FIG. 32.—*Sandelia capensis*. Juveniles, 8 mm. and 10 mm. in length.

the headwaters of the rivers flowing across it, except in two particulars: *Sandelia* appears to be absent from the whole of the Clanwilliam Olifants system; and (at least at the present day) from all streams on the Cape Peninsula except the Liesbeek and the Diep (Lakeside) rivers.

If the assumption be granted that the Kurper never was present in the Palmiet, Silvermine, Schusters, and Klaasjagers rivers on the Cape Peninsula, the fact that there is no means by which a purely *freshwater* fish could get to these rivers from the Cape Flats, seems to point to the Kurper having arrived after the land had begun to rise. On the other hand, at the time of maximum elevation of the land the whole of False Bay would have been dry land, and the Silvermine and Diep rivers were probably connected. Did the Kurper formerly live in the Silvermine stream, and has it for some reason been unable to maintain itself? This does not seem likely, as it is a very hardy fish; but, as we shall never know whether the

Kurper did actually live in the Silvermine, the problem must remain unsolved.

We can, however, say that *Sandelia* was present in the Breede River system either before or during the period of maximum elevation, because it is present in the Nieuwejaars, Grashoek, and Kars rivers, which are now cut off from communication with the Breede River.

The finding of the Kurper as far north as Leipoldtville on the west coast belt intensifies the question as to why it has not (apparently) penetrated into the Olifants River (Clanwilliam) system. The Jackals River, flowing through Graafwater to Lambert's Bay, seems to be mostly dry and to have no fish-fauna at the present day.

In some specimens from Zoetendals Vlei, Bredasdorp district, Dr. V. Fitzsimons of the Transvaal Museum has found specimens of the Fish-louse *Argulus*.

Sandelia bainsii Cast.

Bain's or Eastern Province Kurper, Rockey.

1916. Boulenger, *l.c.*, p. 52, fig. 29.

1917. Gilchrist and Thompson, *l.c.*, p. 546, fig. 159.

This species is distinguished by the more pointed snout and the slightly smaller scales. The scales on the upper part of the body are distinctly smaller than those in the middle of the side, 6–7 between lateral line and origin of dorsal fin.

There are 22 scales around the caudal peduncle in the larger specimens and 20 in young specimens up to 60 mm. in length.

The opercular spines are distinctly more acute than in *capensis*. Either the upper or lower spine, or both, and either on one side only or on both sides, may be bifid. Bifurcation might be due to injury, but probably occurs as a normal concomitant of growth. In young specimens both spines are acute and entire, but with traces of incipient bifurcation.

The two groups of opercular spines is one of the characters on which Castelnau based his genus *Sandelia* in contradistinction to *Spirobranchus*. As shown above, however, there is no essential difference between these spines in *capensis* and *bainsii* which would warrant generic separation. But both *capensis* and *bainsii* are sharply distinguished in this respect from the typical species of *Anabas* (s.s.) and *Ctenopoma*.

Castelnau's type came from the Kowie River near Grahamstown. Boulenger's record, "Buffalo River, Port Elizabeth," should, it seems, be corrected to Buffalo River, East London.

According to Mr. Harrison's investigations, the Rockey occurs in the Nahoon River, but is unknown to local fishermen in the Kubusie River at Stutterheim (a tributary of the Great Kei River).

The largest specimen I have seen is that recorded by Gilchrist and Thompson from King William's Town (its total length is 115 mm.). I have also examined two small ones from the Pirie Trout Hatchery near King William's Town, and a series, 45 mm. to 110 mm., collected by Mr. A. C. Harrison (Oct. 1941) from the Tyusha stream near Pirie (a tributary of the Buffalo River).

The colour when freshly caught is dull olive-green, with very few and indistinct markings (A. C. H.).

Family CLUPEIDAE.

Gen. Gilchristella Fowler.

1935. Fowler, Proc. Ac. Nat. Sci. Philad., lxxxvii, p. 365.

Gilchristella aestuarius (Gilch.)

Whitebait.

1913. Gilchrist, Mar. Biol. Rep., i, p. 55, fig. (*Spratelloides a.*).

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 109 (*Spratelloides a.*).

1935. Fowler, *l.c.*, p. 365, fig. 4.

1934. Harrison, Fish. Mar. Biol. Surv., Investigat. Rep. 4, pp. 22, 63, 64, 80 (*Spratelloides*, localities).

1936. *Id.*, *ibid.*, Investigat. Rep. 7, pp. 94 ("Gillieminkies, a small *Barbus*, probably *burchelli*") and 96 (*Spratelloides*).

1937. J. L. B. Smith, *l.c.*, p. 139.

In addition to Princess Vlei, Cape Flats, and the Zwartkops River, Port Elizabeth, this little fish has been caught at the following localities:—

Verloren Vlei, near mouth (Piquetberg Division).

Lakeside, Cape Flats.

Brand Vlei and Breede River, Worcester (permanently fresh, 100 miles, as crow flies, from mouth of Breede River).

Zonder End River, at Genadendal.

Klein River, Stanford.

Nieuwejaars River, Elim; Grashoek and Kars River, Bredasdorp.

Groen Vlei, Knysna.

Blue Lagoon, Umgeni, Natal (Fowler).

Family MUGILIDAE.

1935. J. L. B. Smith, Ann. S. Afr. Mus., xxx, p. 587 (revision of S. African species).

Although the majority of the South African Harders or Springers enter estuaries and rivers, only the three mentioned below appear to be actually recorded from fresh water.

Mugil cephalus (with well-developed adipose eye-lids, pointed scale in axil of pectoral, and no scales on soft dorsal fin) was recorded by Cuvier and Valenciennes (as *constantiae*) from one of the vleis near Constantia, Cape Peninsula; and by Weber (1897) from Little Princess Vlei.

The South African Museum has specimens from Lakeside and Zeekoe Vlei (Cape Flats): Wilde Vogel Vlei, Kommetje; Klaasjagers Lagoon (Cape Peninsula).

Mugil capito (with feebly developed or no adipose eye-lids, soft dorsal scaly only at base, pointed scale in axil of pectoral) is recorded from the Berg River (Boulenger, 1916), probably from near the mouth in St. Helena Bay. The South African Museum has collected specimens at the mouth of the Olifants River (Van Rhynsdorp Division), and Verloren Vlei (Piquetberg Division).

Mugil euronotus (with feebly developed or no adipose eye-lids, soft dorsal completely scaly, no pointed scale in axil of pectoral). Specimens of this species have been caught in the Valsch River, a tributary of the Gouritz River, Albertinia Division.

Family ANGUILLIDAE.

Anguilla mossambica (Peters)

Freshwater Eel; Paling.

1897. Weber, Zool. Jahrb. Abt. Syst., x, p. 155 (*delalandii*).

1917. Gilchrist and Thompson, *l.c.*, p. 466, figs. 111*a*, 112.

1925. Barnard, Ann. S. Afr. Mus., xxi, p. 175, and 1927, *ibid.*, p. 1018.

1935. *Id.*, Rep. S. Afr. Mus. for 1934, p. 10 (elver).

1937. *Id.*, Ann. S. Afr. Mus., xxxii, p. 49 (elver).

As mentioned in the appendix to the Monograph of Marine Fishes (1927, p. 1018), the researches of the late Dr. J. Schmidt showed that only this one species of Freshwater Eel occurs in South Africa.

Although it is generally known that eels are found in all or most of the southward and eastward flowing rivers in the Cape area under

discussion, the only definite recent records are those given by Weber, viz. Kammanassie River at Oudtshoorn; Kafferkuil River at Riversdale; and Duivenhoeks River at Heidelberg (Cape). At the last-mentioned locality Ensign Schrijver caught some on 17th January 1689.*

The South African Museum has a specimen caught by Mr. F. G. Chaplin at Jonkershoek in the Eerste River near Stellenbosch. Mr. A. C. Harrison caught one in a stream on the south side of Potteberg near the mouth of the Breede River, and below the dam on the Steenbras River; one was caught in Ruigte Vlei, between George and Knysna (C. W. T., Oct. 1938), and another in a tributary of the Kruis River, 5 miles north of Knysna (Nov. 1938). According to several verbal reports eels are common all along the River Zonder End.†

In addition to Dr. Kannemeyer's Orange River specimen,‡ Gilchrist informed Schmidt (*in litt.* 29/xii/08) that one large specimen was caught in a stream which ultimately joins the Orange River, but near the watershed of the Crocodile and Orange rivers in the Pretoria district.§ Both these records would seem to be satisfactorily explained by overland migration. The intensification of the main Cape watershed would seem to have cut off all possibility of migration from the southeast-flowing rivers into the Orange River system, except in rare instances.

In the case of the record from the Liesbeek River, overland migration was certainly possible.‖ Although this stream rises on the eastern slopes of Table Mt. and flows northwards into Table Bay, it is joined not far from the coast by the Kromboom stream, which rises on the Cape Flats (*cf.* fig. 28). Between the source of the latter and one of the sources of the southward-flowing Diep River there was (in 1891, when this eel was caught) a stretch of some two miles of low-lying marsh and meadow-land: by no means an insuperable barrier.

An earlier record occurs in van Riebeeck's Journal ¶ of an eel in the "Fresh River," *i.e.* the stream flowing through the settlement where Cape Town now stands, in opposition to the "Salt River."

* Van Riebeeck Society Publ., xii, p. 215, 1931, Cape Town. W. W. Thompson, Sea Fisheries of the Cape Colony, p. 134, Cape Town, 1913.

† See Hey, *l.c.*, Reports, i–iii.

‡ Kannemeyer, Proc. 26/vi/95 in Trans. S. Afr. Philos. Soc., viii, p. xcvii, 1896. Barnard, *l.c.*, *supra*, 1925, p. 176.

§ Schmidt, K. Dansk. Vid. Selsk. Skr., ser. 8, vol. x, p. 334, 1925.

‖ Barnard, *l.c.*, p. 176, 1925.

¶ W. W. Thompson, *l.c.*, p. 134, 1913.

It is possible that this record refers to the Liesbeek, the old name of which was *Vers Rivier* (= *Vars* = Fresh).*

Apart from the possible unsuitableness of the rivers on the west coast of South Africa owing to their being mainly periodical, the absence of Freshwater Eels from these westward-flowing rivers seems to be due to past oceanographical factors in the South Atlantic Ocean. Eels are in fact absent from the whole of the *west* coast of Africa as far north as about 15° N. lat., and from the *east* coast of South America as far as about 5° N. lat.† It is just these parts of these two continents which, on the Taylor-Wegener Displacement Hypothesis, were formerly much closer together than they are to-day. In other words, there was no South Atlantic Ocean in which these eels could breed.‡

Freshwater Eels breed in the deep waters of the ocean; and the spawning-grounds of the South African eel lie in the region of the Madagascan Deep. Schmidt says: " . . . in the western part of the Indian Ocean the larvae of three species were found, viz. *Anguilla bicolor*, *Anguilla mossambica*, *Anguilla mauritiana*" [*i.e.* the East African, South African, and Madagascan species].§

Up to the present only one specimen of the elver of *A. mossambica* has been recorded, although verbal reports indicate that the arrival of the elvers and their ascent of the rivers is well known to many people in Natal.‖

The correlation of the *Leptocephalus* larva and the elver with the adult is based on the number of myotomes (muscle-bands) and vertebrae. Each species has a definite and characteristic number of vertebrae, within certain rather narrow limits; that of *A. mossambica* being 100–105.

In view of Schmidt's discovery of the *Leptocephalus* larva of *A. mossambica*, and the record of the elver, it is a little difficult to understand the unorthodox and rather startling suggestion made by Dr. J. L. B. Smith. It would be interesting to know the nature of the evidence which is said to be accumulating to show that the South African Freshwater Eel may have a life-history entirely different from that of any other species.¶

* C. Graham Botha, Place Names in the Cape Province, Cape Town (Preface dated Dec. 1926), p. 79.

† Schmidt, *l.c.*, p. 367 and pl. 1, 1925.

‡ A. L. du Toit, Our Wandering Continents, 1937.

§ Schmidt, ed. Tåning, Danish Eel Investigations during Twenty-five Years, p. 8, footnote, Copenhagen, 1932.

‖ Barnard, *l.c.*, *supra*, 1935 and 1937.

¶ J. L. B. Smith, Albany Mus. Guide to Vertebrates, pt. 2, p. 132, 1937.

Family GOBIIDAE.

Gobies (*freshwater*).

Only the Cape species are discussed, but a synopsis of the fluviatile species is given. In estuaries several of the marine species are likely to be found, and for the identification of these the key in Barnard, Marine Fishes S. Afr. (Ann. S. Afr. Mus., xxi, p. 813, 1927), may be used.

Synopsis of Fluviatile Species.

I. Gill-membranes free from isthmus, gill-opening very wide (fig. 33, *a*). Dorsal and anal rays (branched) 9–10. Scales in lateral series 29–31. An irregular patch of scales on throat . . *Psammogobius knysnaensis.*

II. Gill-membranes united to isthmus, gill-opening restricted (fig. 33, *b*) . *Gobius.*

A. Lower jaw projecting beyond upper jaw.

1. Dorsal and anal (branched) rays 7. Scales in lat. series 20 *silvanus.*

2. Dorsal and anal rays 8–9.

a. Scales in lat. series 28–36. Mouth extending to below front margin of eye. Scales on throat present or absent . *giuris.*

b. Scales in lat. series 26. Mouth wide, extending to below hind margin of eye . . . . . *dewaali* (Natal).

B. Upper jaw overhanging lower jaw. Dorsal and anal rays 10. Scales in lat. series 58–64. No scales on throat *aeneofuscus* (Natal, Transvaal, Rhodesia, East Africa).

Psammogobius knysnaensis J. L. B. Smith

Fig. 33, *a*.

1935. J. L. B. Smith, Rec. Albany Mus., iv, p. 215.

Recorded from the tidal portions of the Breede, Knysna, Keurbooms, Bushmans, and Kowie rivers.

Gobius silvanus n. sp.

Head $3\frac{1}{2}$ in length (excluding caudal), eye 3 in length of head. Lower jaw projecting, mouth extending to below front margin of eye (or very slightly farther back). Snout scarcely $\frac{1}{2}$ length of eye. Tongue free, rounded. Teeth in 2–3 rows in both jaws, no canines. Gill-rakers 6–8 feeble knobs on lower part of anterior arch. Mucus pores (difficult to trace) a row along lower margin of orbit, one horizontal row across cheek, a row along lower margin of preopercle.

D vi. + i. 7. A i. 7. Caudal shorter than head. Rays of each ventral fin very flimsily connected, and apparently no membrane connecting the two fins posteriorly.

Scales in lat. series 20, transv. series 7, around caudal peduncle 12. Head naked; a triangular naked patch extending back almost to origin of dorsal fin, only 1–2 predorsal scales in middle line.

Colour (as preserved) pale with minute grey speckling, chiefly on upper parts; some of the scales brownish, or outlined in brown,

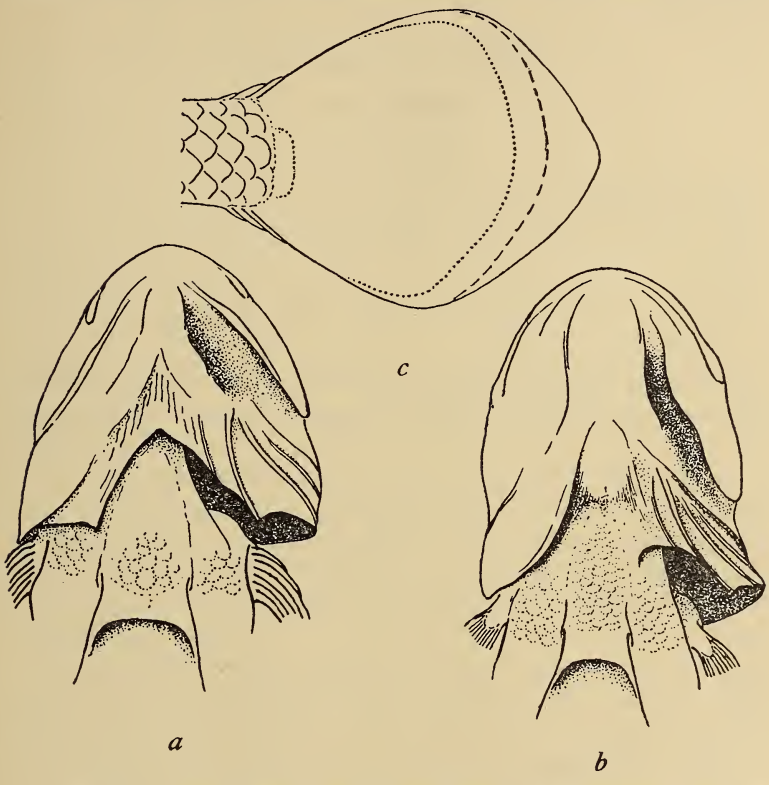


Fig. 33.—Ventral views of head, showing extent of gill membranc, and scaling on throat, in (*a*) *Psammogobius*, and (*b*) *Gobius*. (Pectoral and ventral fins not completely shown.) (*c*) Caudal fin of *Gobius giuris*: shorter than (dotted), equal to (broken line), and longer than length of head (full line).

producing an irregular and variable dappled appearance; 3–4 darker (blackish) spots on hinder part of mid-ventral line, the foremost being at, and divided by, the anal fin, and one spot at base of middle caudal rays; spinous dorsal with a black blotch. Ova showing through body wall as yellowish-orange patch.

Length: 20–22 mm. (including ovigerous ♀♀).

Locality.—Knysna Lagoon (C. W. Thorne and H. G. Wood, Oct. 1938).

Remarks.—This little Goby has fewer scales in the lateral series than any other South African species. The specific name in allusion to the two collectors, and the appearance of sylvan light and shade on the body.

Gobius giuris Ham. Buch.

Flat-head Goby.

Fig. 33, *b*, *c*.

1916. Boulenger, *l.c.*, iv, p. 24, fig. 15.

1927. Barnard, Ann. S. Afr. Mus., xxi, p. 814.

1936. J. L. B. Smith, Trans. Roy. Soc. S. Afr., xxiv, p. 49, fig. 2 (*gulosus*).

1937. *Id.*, Guide Vert. Fauna East. Cape Prov., pt. 2, p. 137, fig. 4 (*callidus*).

This species grows to a length of about 300 mm. in Natal and the Transvaal, but the South African Museum has no specimens over 100 mm. from localities in the Cape Province. Nor is there a series of young or half-grown from Natal or the Transvaal, so that I am unable to say at what size breeding starts in those regions.

Recent collecting of series of specimens in the Zwartkops River (Uitenhage), Gamtoos River, and Kromme River (Assegai Bush) shows that in this part of the Cape Province breeding starts at a length of about 43 mm. No specimens over 100 mm. were obtained, so that I cannot say to what size this fish may grow in Cape rivers.

Examination of the material shows the following points. In my 1927 description of the species, the gill-rakers were said to be obsolete. That is more or less true of large specimens, merely 7 or 8 very short knobs being present. But a series seems to show that after an initial increase from 7 or 8 to 10 or 11 there is a subsequent reduction in the number and in the length of the rakers (see table, p. 262).

The scales on the throat (the triangular area between the ventral fins and the isthmus) are variable. In the large specimens the area is completely scaled, and likewise in a series of small specimens (23–100 mm.) from the Buffalo River (King William's Town and East London). On the other hand the Gamtoos River series shows absence of scales in the young up to about 30 mm., and their gradual development in specimens over that length. In the Kromme River

series the scales seem tardy in developing, first appearing in some specimens of 75 mm., but being absent in others 80–90 mm. None of the Zwartkops River series (up to 85 mm.) have throat scales. This character therefore cannot be used for specific differentiation.

The scaling on the occipital region is subject to growth, but appears to follow a more regular development. In the smallest specimens the whole occipital region is naked, extending back almost to the origin of the dorsal fin, in front of which only 1 to 2 or 3 scales are traceable. With the development of 4–5 predorsal scales the scaling extends forwards to about the level of the hind margin of opercle, and with 6–7 or 8 scales to about midway between the opercle and preopercle. When fully developed there are 14–16 scales together with some 4 or 5 small irregular, often indistinct, ones in front (*ca.* 20 in all), extending to or almost to the level of the hind margin of the eyes. The Buffalo River specimens are well-scaled for their size, in comparison with the other series (*cf.* throat-scaling, *supra*).

The number of scales in a transverse series (between bases of soft dorsal and anal) may increase with age, but a longer series should be examined from localities where the fishes are known to reach a size of 250 or 300 mm.

The dorsal and anal branched fin-rays number usually 9 and 8 respectively; but in the Zwartkops River specimens the normal formula is 10/9, only occasionally 9/8, and in one instance 9/9 (a second case of this latter in one specimen from Van Stadens River). I have seen no specimen with 8/7 (as in *gulosus*), but there are 2 from Assegai Bush with 9/7.

The caudal fin, *when fully expanded* (which cannot be done in specimens much hardened in strong preservative), forms a broad fan with rounded margin. Neither Peters' figure (reproduced in Boulenger, fig. 15) nor J. L. B. Smith's figure (1936 and 1937) are correct, both being based on incompletely expanded caudal fins. The roundness or pointedness of the caudal fin is not a character, but the length of the middle caudal rays is a feature which deserves consideration, together with the length of the pectoral, in relation to the head-length (fig. 33, *c*).

Like other features, the lengths of these two fins seem to be dependent on growth, and to be variable at that. They seem to increase in length with growth up to 100 mm., and may equal the length of the head, or in the case of the caudal fin may exceed it. But the increase is not regular or constant in a series of specimens, especially in series from different localities. Further, when the largest specimens

are measured there seems to be a retrogression (*cf.* the 3 Umkomas specimens); but unfortunately I have no long series from the very young upwards from any locality in Natal or the Transvaal.

The tables, however, give sufficient indication of the truth of Day's remark (1878–1888, Fish. India, p. 295): "The fins are subject to very great variations as to the length of the spines and rays"; and of the necessity of a detailed investigation of long series from many localities.

Even on the basis of the very small amount of material available, I am unable to admit the validity of *gulosus*, based on a single specimen, whose *only* unusual feature is the fin formula 8/7. This is surely an individual abnormality (*cf.* the Assegai Bush specimens). It would be inadvisable to claim specific rank for any of the present series until we know the growth-changes, and the size when breeding starts, in communities in Natal and the Transvaal.

The eggs are of the characteristic oval shape; and the nearly ripe gonads can be seen as a yellowish patch through the body-wall at a length of 38 mm. (Kromme River). The fully ripe ♂♂ and ♀♀ from 43 mm. upwards were taken in late October.

Addendum and Corrigendum to p. 153.

Barbus aeneus (Burchell)

syn. *B. holubi* Stndr.

Burchell (1822, Travels Int. S. Afr., vol. i, p. 280, fig. on p. 284) described "*Cyprinus*" *aeneus*, and (*ibid.*, p. 425, fig. on p. 445) "*Silurus*" *gariepinus*. The latter was accepted by Günther and Boulenger, but, for no apparent reason, not the former.

As regards *gariepinus*, Burchell gave no characters by which this species can be distinguished from, e.g., *mossambicus*. Burchell's species is not recognisable except on a geographical basis; it is typical of the Orange River and apparently the only species found in that river.

On this basis *aeneus* is also recognisable, although the description does not fulfil modern requirements. But is the description entirely inadequate? The description states that the head is small (cf. *supra*, p. 157, and fig. 8); the figure shows an elongate anal fin, and was made from a fish 19½ inches in length; the locality was the Zak River.

As *B. holubi* is known from the Zak River, and the main Orange River, and is the only large species of Barbus in this system, Burchell's species is clearly recognisable. Therefore his earlier name should be accepted in place of Steindachner's.

The colloquial name (pp. 121, 153) should be changed to Orange River Yellow-fish.